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CHANGES OF RETENTION OF PANCREATIC SECRETION¹

JOSIEF BAIÓ MD SZIGET HUNGARY

AND

HARRY C. HAMILTON MD MONTREAL CANADA

OF LATE considerable attention has been directed to the pathological changes in the biliary tract subsequent to alterations in the papilla of Vater. Relatively little attention has been paid however to the results of such pathological changes in the papilla of Vater upon the duct of Wirsung the duct system of the pancreas and upon the pancreas itself. Much of this inattention is due to the fact that because of early postmortem changes it is difficult to collect suitable material for study.

In this communication we propose to discuss the different factors which through their effect upon the diverticulum of Vater may produce changes not only in the duct system of the pancreas but in the parenchyma of the pancreas and in the islands of Langerhans and we will consider as well the more remote pathological changes in the organism. In our work we studied especially the competency of the partially or completely altered pancreatic duct system that is the effect of partial or complete retention of pancreatic secretion.

In order to do this material was obtained from a series of 963 consecutive autopsy examinations carried out at the Pathological Department of the Saint Stephen's Hospital Budapest. Our observations proved that the conditions discussed are relatively frequent and that those same factors which on some

occasions may attract attention because they produce relatively acute clinical signs such as pain and evidences of biliary obstruction may on other occasions cause changes in the pancreas which become evident early or remain latent for a considerable period then manifest themselves through disturbances in metabolism and other consequences.

We have divided the factors which cause obstructive changes in the duct system of the pancreas into two groups the acute and the chronic. These we shall illustrate by selected cases.

In the group of acute cases we have included those showing the result of acute inflammatory processes of the diverticulum of Vater which may be followed by necrosis of pancreatic tissue. In this group may also be included the cases showing the result of incarcerated gall stones but these cases will not be discussed in this paper.

ASSOCIATION OF CATARRHAL JAUNDICE WITH ACUTE FOCAL NECROSIS OF PANCREAS

The first four cases described which fall into the group of acute cases illustrate how simple catarrhal jaundice without stone due to swelling of the duodenum and the papilla duodenalis major may cause retention of pancreatic secretion simultaneous jaundice and focal necrosis as a result of acute retention of pancreatic juice.

¹ F mth P th l c l D p m t l th M t p o l t a S t St p h e
H g R y I F J g I U

H p l B d p t d th P th l g l A t m l l t t t f h
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On April 30, 1911, the patient had an attack of pain and vomiting, jaundiced and in the morning the examination on May 4 revealed irregular and not very sluggish both in the Achill's reflex and the hypersthesia over the extremities. The next day the patient died. One week later the patient was a positive teller of the disease. He died in the hospital. The final mucous membrane of the gall bladder and the pancreas and the spleen of the patient were examined. The findings of the histological examination of the pancreas and the spleen were as follows: The pancreas was enlarged and the spleen was enlarged. The findings of the histological examination of the pancreas and the spleen were as follows: The pancreas was enlarged and the spleen was enlarged.

We may here state what appear to be an opportune moment to make some brief remarks concerning the size of the islands of Langerhans. Several islands of Langerhans measure 600 microns in diameter. Heber (1) has found an island which measured 500 by 360 microns, and Weibelbaum (2) where they measured 500 microns. According to Sobolew (3) they may reach the size of 1.5 millimeter. When this size was reached in the case reported by him, he spoke of a struma of the islands of Langerhans.

Autopsy findings. The heart showed an atherosclerotic and recent aortic and mitral endocarditis. The duodenum and papilla of Vater were congested. The biliary ducts were free. Histological examination of the pancreas showed the effects of the retention of secretion. Spread all over the pancreas particularly on the surface were focal necrotic areas the size of millet seed (fig. 1). The ducts were dilated and filled with a homogeneous secretion. The cells lining the ducts were flattened (fig. 2). The islands of Langerhans were hypertrophied (figs. 3 and 4) and were increased in number and size particularly in the tail of the pancreas.

We believe that the first four cases that we have recorded prove that acute retention of pancreatic secretion may occur in the pancreas and that the effects of this may be demonstrated. In three cases the swelling of the duodenal mucous membrane was due to incompetent heart action secondary to an endocarditis. In two of these cases the lesion in the heart was a recurrent verrucous endocarditis; in one case it was a chronic endocarditis and myocarditis. In all three cases the icterus appeared only during the last stage of the disease and this period was in every instance a short one.

Jaundice in cases of cardiac insufficiency has usually been considered as the result of pressure upon the biliary ducts by dilated blood vessels.

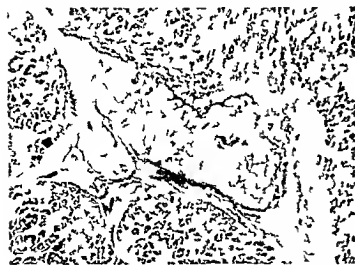


Fig 1 Case 4 Photomicrograph low power of a necrotic area in the pancreas surrounded by leucocytes

pancreas Roessle (28) has published the report of one case of anemic infarctions in the pancreas resulting from thrombosis in the arteries. Roessle regards his case as unique in the literature.

Since we have found circumscribed necrotic areas in the pancreas without evidence of embolic phenomena and since we have found the pancreatic ducts and end chambers dilated we believe that the lesions in the pancreas in the cases which we have reported resulted from retention and stasis of pancreatic secretion. This point being accepted we must further conclude that the lesions

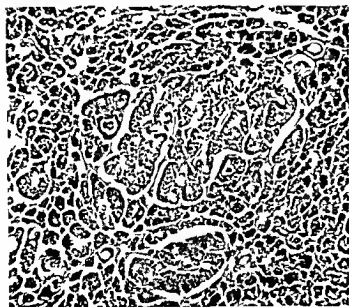


Fig 3 Case 4 Photomicrograph low power. Note the hypertrophied islets of Langerhans and the dilated ducts around it.



Fig 2 Case 4 Photomicrograph high power. The ducts and end chamber of the pancreas are greatly dilated and the cells lining the acini are flattened.

resulted from and were secondary to the swelling of the duodenal mucous membrane and papilla of Vater which caused simultaneously icterus and retention of pancreatic secretion.

That these facts must be considered seriously is proved by our first case. This was one of so-called catarrhal jaundice which ended fatally. One must appreciate that such cases rarely come to necropsy but usually recover. In the clinical history in this case it is noted that the onset of the present illness followed a dietary indiscretion. This appar-



Fig 4 Case 4 Photomicrograph low power. In the center of the field one sees an enlarged islet of Langerhans with greatly dilated blood capillaries.

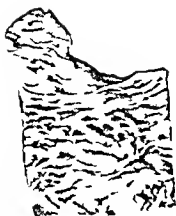


FIG. 1. Section of pancreas showing hypertrophy of the islet of Langerhans.



FIG. 2. Section of pancreas showing hypertrophy of the islet of Langerhans.

ately produced a gastritis and duodenitis, one of the complications being a cholangitis. The pancreatic ducts were found dilated up to the normal limit.

In this case a well marked hypertrophy of the islet of Langerhans was to be noted which was also observed in our fourth case of chronic myeloma which was followed by jaundice.

Consulting literature upon the action and the physiological duct dilatation and starvation in relation with regard to the hypertrophy of the islet of Langerhans is rather limited. We refer to the early work of Zuntz¹⁸ and to the more recent work of L. Kunitz,¹⁹ Minell,²⁰ Herdheimer²¹ and Carpenter.²² The workers all proved that ligation of the main pancreatic duct from about its origin to the point where it is in communication with the islet of Langerhans is necessary and profitable. There are also a few cases described in the literature in which hypothyroidism with excretory symptoms were noted and in which the origin of the hypothyroidism was established. Such cases have been reported by H. von L. Herne,²³ etc.

Several theories which have been advanced in regard to the hypertrophy of the islet of Langerhans have been described. Among these may be mentioned secretion of a humoral factor for the stimulation of the pineal gland, the adrenaline gland, and the suprarenal gland. But this has recently been shown that it is not the agent pro-

duce no such effect. Nevertheless, as Jorm²⁴ among others has recently proved, starvation always causes a hypertrophy of the islet of Langerhans. Beside starvation the other undoubted cause of regeneration of the islet of Langerhans is the ligation of the pancreatic duct.

In our two cases in which there is of pancreatic juice was proved we found hypertrophy of the islet of Langerhans. We therefore believe that the stasis of the pancreatic juice results even from a catarrh of the duodenum and swelling of the papilla of Vater which brings about catarrhal jaundice must be regarded as a factor which may also cause hypertrophy of the islet of Langerhans. It seems that the stasis of pancreatic juice is present in all cases of catarrhal jaundice.

Von Chhn and Chobot²⁵ report atrophic changes in the pancreatic parenchyma occurring in patients with uncompensated cardiac disease associated with general venous stasis. They state that in general the duration of the final cardiac failure and the existing changes in the liver bear direct relation to the changes in the pancreas. These workers have also noted slight connective tissue changes but no such changes in the islet of Langerhans as we have noted. They make no mention of jaundice in any of their cases.

We believe that stasis of pancreatic juice and catarrhal jaundice may be due to alteration in the papilla duodenalis may be. These changes are usually concomitant but



Fig. 8 Case 10. The main duct of the pancreas opening into the papilla of Vater. In the middle of the opened duodenum one notes the common bile duct.

we cannot exclude the possibility that one may occur without the other. That they occasionally occur separately may perhaps be explained upon the basis of anatomical and pathological variations of the opening in the duodenum of the common bile duct and the duct of Wirsung.

CHRONIC PATHOLOGICAL CHANGES IN THE PAPILLA OF VATER AND WITHIN THE PANCREAS PROBABLY RESPONSIBLE FOR OBSTRUCTIVE CHANGES IN THE DUCT SYSTEM OF THE PANCREAS

Among those chronic changes which we have considered responsible for changes in the pancreatic duct system we have included the following: (1) those changes which affect the papilla of Vater and (2) those changes which occur within the duct system of the pancreas. The former constitute alterations which follow acute inflammations of the papilla of Vater. Among those changes affecting the papilla one must also include scar formation about the papilla, double duct openings and other consequences of gall stones. Diverticula of the duodenum, polypi of the papilla and malignant tumors of the papilla of Vater must also be included in this group. Changes within the duct system of the pancreas include inflammatory thickening of the ducts, pancreatic calculi, tuberculosis and new growths.

THE DUCT SYSTEM OF THE PANCREAS

We do not propose to consider the general anatomical arrangement of the duct system of the pancreas. This has already been most



Fig. 9 Case 11. A small polyp 1 to 1.5 cm near the opening of the duct of Wirsung. The common bile duct has been opened. One can see the branching of the cystic duct.

adequately done by Opie (24), Heiberg (13) and others. We shall however repeat one or two anatomical facts which although well known bear repetition particularly since they are of importance in the discussion of the cases here cited.

The duct system of the pancreas consists of a main duct which usually traverses the whole gland and has many branches. From the main duct there usually branches the accessory duct of Santorini. Opie states that although the ducts may vary much in their relative size two are usually present although at times one may have undergone partial obliteration. In a large series of cases our experience has been similar in this respect. The accessory duct of Santorini terminates in the papilla duodenalis minor, the main duct of Wirsung in the papilla duodenalis major. With the common bile duct the latter forms the diverticulum of Vater.

Throughout this discussion we will refer to the main duct of the pancreas as the duct of Wirsung only if the entire duct is present and is patent up to the diverticulum of Vater; otherwise we shall speak only of the main duct of the pancreas, for in several instances the main duct was found to vary in its course.



Fig. 9 Case 1. The dilated duct of the pancreas has been opened. In the head of the pancreas there is a cyst.

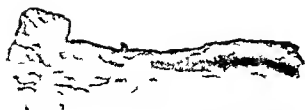


Fig. 1. Cystic duct, showing the effect of the alteration in the papilla of Vater upon the pancreas. It will be noted that the cystic duct were present in all 6 cases. The alteration in the papilla of Vater is not due to the attributed to gall stones.

mucosa. The duct directed to the papilla of Vater is shown.

The following illustrations illustrate the effect of the alteration in the papilla of Vater upon the pancreas. It will be noted that the cystic duct were present in all 6 cases. The alteration in the papilla of Vater is not due to the attributed to gall stones.

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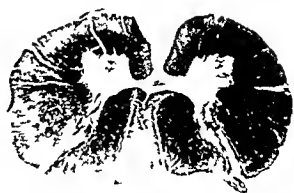


Fig. 2. Cystic duct, showing the effect of the alteration in the papilla of Vater upon the pancreas. It will be noted that the cystic duct were present in all 6 cases. The alteration in the papilla of Vater is not due to the attributed to gall stones.

duct is thickened. The scar of the papilla is attributed to gall stones.

Case 6. The patient, an obese female, aged 44 years, who was operated upon for an empyema of the gall bladder and who succumbed during the operation. The gall bladder was found to be enlarged and the cystic duct was found to be thickened. The main bile duct (Fig. 5). The second opening had a longitudinal diameter of 6 millimeters and was 3 millimeters above the main opening. The pancreas showed moderate lipomatosis. The histological findings were those of a chronic pancreatitis.

Case 7. The patient, a male, aged 55 years, who was operated upon for a fistula in the right lung. The patient had suffered from diabetes mellitus. The cause of death was pulmonary tuberculosis.

An opening in the pericardium the size of a walnut was found in the subcutaneous tissue of the chest wall, all of the diaphragm and the abdominal wall. The opening was surrounded by a thickened area of tissue. The opening was found to be a communication between the pericardium and the subcutaneous tissue. The opening was found to be a communication between the pericardium and the subcutaneous tissue.

The following illustrations illustrate the effect of the alteration in the papilla of Vater upon the pancreas. It will be noted that the cystic duct were present in all 6 cases. The alteration in the papilla of Vater is not due to the attributed to gall stones.

Case 8. Female, aged 66 years. The patient had a long history of diabetes mellitus and had been treated with insulin. The patient had died of a cerebral embolism. The autopsy showed a large, well-defined, encapsulated, yellowish, lobulated mass in the right paracolic region, which was found to be a large, well-defined, encapsulated, yellowish, lobulated mass in the right paracolic region.



Fig 13 Case 14 This plate shows the pancreas with part of the duodenum. The pancreatic duct is greatly dilated and is filled with several stones. In the head of the pancreas there is a cyst filled with milky fluid.

In the choledochus 1 centimeter above the papilla of Vater where the stone was lying a decubital ulcer was found which was demonstrated to communicate with the duct of Wirsung by an opening which was permeable to an ordinary metal sound. The pancreas showed marked pancreatitis on histological examination.

CASE 9. Male aged 61 years. On admission September 19, 1917 the patient was found to be slightly jaundiced and quite obese. His urine contained considerable sugar. Knee jerks were absent. The Wassermann reaction was negative.

When the abdomen was opened at necropsy scattered grayish yellow areas of varying size were seen. They all gave a positive Bender reaction. The pancreas weighed 455 grams and contained several areas similar to those already described. The opening of the duct of Wirsung could not be found. The gall bladder contained a large rough combination stone which had become fractured and so several smaller particles were lying free. The cystic duct was permeable the common bile duct slightly dilated. The main duct of the pancreas was found to be very much dilated and to open into the papilla duodenalis minor. In the pancreas large areas of necrosis were seen. When cut these areas were seen to be surrounded by many leucocytes. Other normal areas of pancreatic tissue were surrounded by fat. The islands of Langerhans were destroyed. In the nervous system an accumulation of corpora amyloidea was noted in the medulla island of Reil and in the posterior column of the spinal cord.

In this pancreas we have found a combination of lipomatosis with recent necrosis. We attribute the lipomatosis to a former necrosis.

CASE 10. Female aged 60 years. One month previous to her admission patient suffered a left sided hemiplegia. At necropsy the gall bladder was found shrunken and filled with a single stone. The cystic duct was obliterated the common bile duct very much dilated although the opening of the common bile duct to the duodenum was normal. The outlet of the duct of Wirsung could not be



Fig 14 Case 15 Photomicrograph low power. Tuberculosis of the pancreas. In the middle of the section one notes a caseous area. At the periphery of this area one notes giant cells and pancreatic acini surrounded by connective tissue which shows round cell infiltration.

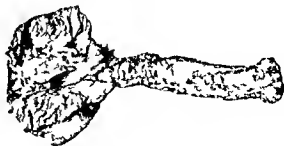
found. The main duct of the pancreas which was markedly dilated opened at the papilla Santorini (Fig 7). The pancreas was atrophic. Through the wall of the main pancreatic duct could be seen many small cysts the size of a pea. These cysts were lined with cylindrical epithelium. In the pancreas glandular tissue was frequently replaced by fat and in these areas only the islands of Langerhans could be noted. There was also an increase in the amount of fibrous connective tissue throughout the pancreas.

EFFECT OF TUMORS OF THE PAPILLA OF VATER UPON THE PANCREAS

The three cases which follow illustrate the effect of tumors of the papilla of Vater. In one case the tumor was a polyp in the two others it proved to be carcinomata.

CASE 11. Female aged 61 years. From the clinical history appearance of the patient and the blood picture a diagnosis of pernicious anemia was made.

At the outlet of the duct of Wirsung a polyp like projection the size of the head of a match was found (Fig 8). This projection was so situated that it partially obstructed the duct of Wirsung which was dilated but did not affect the common bile duct at all. The common bile duct and duct of Wirsung opened separately into the duodenum without forming a diverticulum. The pancreas weighed 75 grams. A smooth cyst the size of a hazel nut lined with cylindrical epithelium was found in the head of the pancreas (Fig 9). Within the pancreas inter-



T m t a l o 7 T l p p l a o f V t e n m l F o r
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t l g c l l t m g h l l p N t
 t l l k l t f t a l l th l d
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l bul r n l i t l l l r n n t i t i r l f e r
t i l l l t i l h i s v i a l t o b e n o t e f
r u l t h l u t h h a n v r l l l s w r
t h u c k e n l a n l i t l t l l w i t h r o u n d l l

The two following are the two we have cited some-
what in detail because of the interesting find
in particularly those referable to the new
you system.

(Cast: M. L. G. 15) Fralita ar
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 n v i l f p l l

H s t l e f t r e g s t h e t r I t h
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 r n u m e r u i n t h m l l a u r r i n a l
 a r p a r t i c u l a r l y i n t h p r t f t h m d u l l h a b

is inferior to that of the spinal cord. The alterations in the spinal cord did not constitute a definite systematic lesion. The alterations in the brain were focal in character. In the brain the most marked changes were in the number of corpora amylacea present. They could be demonstrated not only below the ependyma in the nucleus in the superficial layer of the corpus callosum but also in the cerebral cortex. Although fat granular cells were not present in abundance in the cerebral cortex and in the median nucleus of the thalamus. Sporochoista imprints in brain and spinal cord were negative. Peripheral nerves were examined but showed no lesion.

Case 3: Male aged 36 years. In 194 the patient was treated for jaundice of 6 weeks duration. In January of 196 he was operated upon for gastric ulcer at which time he was again jaundiced. In 1961 he had an operation for a tumor of the pancreas. He died on March 17, 1967.

Physical examination revealed a closed palpable mass in the epigastrium. The left pupil was very much contracted and reacted sluggishly to light and accommodation. The right pupil did not react at all. Both corneal reflexes were absent. The patient voided a normal amount of urine. The Wassermann reaction was negative. His urine did not contain any sugar.

A large carcinoma which had undergone ulceration was found at the papilla of Vater (Fig. 11). It infiltrated and obstructed the outlet of the duct of Wirsung and that of the common bile duct. The main pancreatic duct was greatly dilated. The greater part of the pancreas was found to be converted into scar tissue in which only areas of pancreatic tissue remained. These areas consisted of a few mostly ducts and islands of Langerhans.

The h g s n the spial corl r confict
chil to th p t rior column (Fig 1) The
sh elg a l generat n hich could be trace
f m th lumia segm nt f the cord t the m lulla
f the l g n rated ar a a conl ralf l s of ner e
f b rs th n scintilrou n urogl as note
Mag al thickening of the neuroglia and l of th
ptal adng t th me lulla was lo to be n ted

The pia was thickened and showed round cell infiltration.

A marked increase in the number of corpora amylacea in the cerebral cortex around the vessels as well as in the subependymal and perivascular spaces was noted. Impregnation stains for spirochæta were negative.

In the last group of our cases the cause of the retention of pancreatic juice was found in the pancreas itself. In this last group we have added those cases in which the cause of the stasis of pancreatic juice was found in the pancreas and in which no alterations in the papilla of Vater occurred. It is not unlikely that in cases in which alterations occur in the papilla of Vater an ascending inflammatory process may also take place in the ducts bring about a thickening of the ducts and be followed by a diffuse or circumscribed stasis of pancreatic secretion.

In the next patient we have a pancreatic lithiasis with cyst formation associated with diabetes mellitus. In 11348 autopsies carried out at the Saint Stephen's Hospital between the years 1916 and 1927 pancreatic calculi were found twice. The history of our case follows.

CASE 14. A male aged 40 years was admitted to the hospital on January 5, 1917. He died 4 weeks later from pulmonary tuberculosis. Urinalysis showed 6.5 per cent sugar, also considerable acetone and diacetic acid. Under insulin treatment the diabetic condition improved.

Autopsy findings. The duct system of the pancreas which contained impacted stones was markedly dilated (Fig. 13). The calculi varied in size from that of a millet seed to that of a bean. In the head of the pancreas there was a cyst the size of a walnut which contained milky fluid. There were also several smaller cysts. Around the dilated duct system the amount of scar and pancreatic tissue varied. There were but few islands of Langerhans to be seen. In many areas nerves were found embedded in scar tissue in some areas granulation tissue actually penetrating between the nerve fibers. There was also a definite increase in the amount of elastic fibers found.

At the level of the third cervical segment of the spinal cord on the left side an area 3 by 4 millimeters was noted the long axis of which lay in the transverse diameter of the cord and occupied the anterior part of the posterior column. This central gliosis was in connection with the neuroglia of the gray matter. The process could be traced upward and downward for a total distance of 2 centimeters. In some areas of the brain the corpora amylacea were very numerous.

In the following case the stasis of pancreatic juice was due to tuberculosis of the pancreas.

CASE 15. Patient was a poorly nourished female aged 25 years. An anatomical diagnosis had been made of old and recent bilateral apical tuberculosis. It should be noted that urinalysis did not disclose sugar at any time.

Necropsy findings. Weight of pancreas 39 grams. Histologically in the substance of the pancreas there was connective tissue proliferation. In the granulating tissue groups of epithelioid cells surround the giant cells were to be seen. There were large caseous areas. Isobules of pancreatic tissue were surrounded and invaded by connective tissue which was rich in fat (Fig. 14). The pancreatic ducts were dilated, the remnant frequently distended and their cell flattened. The islands of Langerhans were larger than usual and were very numerous.

Before we discuss the malignant tumors of the pancreas which may cause retention of pancreatic secretion we shall refer briefly to the prosoplastic proliferation of the duct epithelium described by Priesel (6). Priesel found that in about 10 per cent of the cases which he examined the cylindrical epithelium of the ducts was changed to stratified epithelium. He stated that this proliferative change might act as a mechanical block to the lumen of the duct and that subsequent retention of pancreatic juice might be followed by the formation of several small cysts.

We have observed similar cases (Fig. 15). In Case 16 we found in addition to the proliferation of the epithelium cysts, lipomatosis and small necrotic foci. This proved that in such cases not only cyst formation may occur but that the stagnant pancreatic juice may also bring about necrosis.

In the two last cases an adenocarcinoma and a metastatic lymphosarcoma were responsible for the compression of the pancreatic ducts. Benign or malignant connective tissue tumors, Hodgkin's disease, leucemia and pseudoleukemic infiltrations can probably bring about the same change.

CASE 17. Male aged 64 years. On October 16, 1917, the patient suffered his first attack of abdominal discomfort associated with vomiting. His pupils were small, round and did not react to light or accommodation. The knee jerks and Achilles reflexes were exaggerated. The Wassermann reaction was negative. The urine did not contain any sugar. The patient died on October 25, 1921.

that lipomatosis may be a consequence of scattered foci necroses of the pancreas that is when the detritus in the necrotic area is absorbed a fat replacement occurs. This assumption is based on the findings in animal experiments namely that after ligation of the pancreatic duct the glandular tissue is replaced by fat in which the islands of Langerhans remain intact. We have also observed cases in which the islands of Langerhans were embedded in fat tissue in the pancreas.

In one of the six cases recent necrotic areas were found in the pancreas (Case 9). The pancreas was also lipomatous a condition which we believe was brought on as a result of a former fat necrosis. This speaks for the possibility of exacerbations of acute stasis of pancreatic secretion in a well marked chronic process. It is also possible that the degree of the inflammatory process varies in different parts of the pancreas and that the shrinkage or thickening of certain ducts may cause atrophy or necrosis of pancreatic tissue at different intervals. We have also found cysts in some of our cases. These we believe were caused by a partial shrinkage or blockage of ducts with consecutive dilatation of the distal portion.

The most severe effects of the retention of pancreatic secretion within the pancreas resulted from the obstruction to the duct system of the pancreas by tumors and pancreatic calculi etc. We have described one case in which a polyp of the papilla of Vater was found. This patient also had a cyst in the head of the pancreas and suffered from pernicious anemia. It is probable that because of its anatomical position such a polyp may be readily irritated become inflamed and obstruct the outlet of the duct of Wirsung.

Several authors have discussed the problem of pernicious anemia with regard to pancreatitis. Chvostek (7) suggested that there are occasions when pernicious anemia may be due to alterations in the pancreas. Simon (32) found an increase in the atoxyl resistant lipase which is the pancreas lipase in the serum of patients with pernicious anemia. In our case the alterations in the pancreas in no way differed from those which are commonly found in other types of pancreatitis. The

anemia noted in the fifth case was of course due to the hemorrhages from the intestines and esophageal varices which resulted from the hepatic cirrhosis.

We have also recorded one case of chronic tuberculosis of the pancreas which caused the retention of pancreatic secretion. It is not unlikely that growing or even healed gummatous can cause partial obliteration of the pancreatic duct with dilatation of the distal portion. Gummata of the pancreas in the adult have recently been described by Rinke (11).

It was Iepine and Barrel (21), Wohlgenuth (37) and Osato (25) who found that after ligation of the pancreatic duct the diastase content of the blood increased. Wohlgenuth noted that, after this procedure the diastase content of the blood reached its highest level after 48 hours that a decrease then followed and that after 10 to 14 days the normal level was again reached. Wohlgenuth regarded this phenomenon as a temporary transference of pancreatic diastase to the blood stream. According to Osato the lipase protease and amylase contents of the blood and lymph increase after ligation of the pancreatic duct. Kumura and Ukai (30) believe that the elevation of the amylolytic and the lipolytic contents of the blood is lost when regressive change takes place in the pancreas.

With regard to the variations of blood lipase and its significance as well as the production of blood lipase our knowledge is still imperfect. That the lymphocytes play a part in the production of lipase as has been suggested by Flessenger and Marie (10) as well as by Bergel (3) has not been confirmed by the work of Asehoff and Kamiya. Caro (6) believes that the origin of the serum lipase is the pancreas. Without discussing further the origin of the serum lipase or referring in detail to the work of Kona (27) who differentiated the lipase of different organs on the basis of their resistance to various poisons we would suggest that it seems that in cases in which the retention of pancreatic juice has taken place within the pancreas pancreatic lipase may enter the circulation, or possibly produce an excess over the amount of lipase already present in the circulation.

Regulating mechanisms for the content of

blood lipase must exist. Observations in man have proved that the amyl resistant lipase contents may increase in cases in which the retention of pancreatic juice takes place. We refer to the work of Simon (31), Marcus (23) and Katoh (18). In two of our cases in which carcinoma of the papilla of Vater caused the retention of pancreatic secretion alterations were found in the nervous system. Heiberg (14) has stated that lecithin is normally split by pancreatic juice.

The lesion in the nervous system noted in Case 1 was a degeneration in the posterior columns and in Case 2 in addition to this degenerative alterations in the brain. In both the cases there were no evidences of syphilis. The Wassermann reaction in Case 13 was negative but in both cases jaundice occurred. That abnormal liver function can bring about alterations in the nervous system is well known. There are on record epidemics of jaundice in which nervous symptoms occurred and which cleared up with the disappearance of the jaundice. Such cases have been described by Damsch and Kramer (8) of Cöthlingen. Further we have recorded two other cases, the one being that of a carcinoma of the head of the pancreas (Case 17) and the other pancreatic calculi (Case 14) in both of which obliterative changes in the pancreatic duct system occurred with retention of pancreatic secretion. In these cases it must be noted that the papilla was free and hence no jaundice occurred so that this latter factor may be dismissed as complicating the picture in the cases. In Case 14 a central gliosis was found in the cervical portion of the cord and in Case 17 a lesion similar to syringomyelia. We draw attention to the fact however that in the former case the heart showed a fibrous peritonitis and in this case there was also a diabetic mellitus.

One of us (1) has already described degenerative lesion in the spinal cord which we believe are the result of alterations in the pancreas produced by the retention of pancreatic secretion. Sauerbeck (29) recorded a paraplegia in an animal in which the main duct of the pancreas had been ligated. In China and Japan distomum spatulatum Leuckart or clonorchis sinensis Loos is a

parasite which besides being found in the cat and the dog was also found in the hepatic and pancreatic ducts of man where it produced duct obstruction. Katsurada (19) did not mention nervous symptoms in these cases. Sambuc and Brujein (30) recall beriberi like symptoms which accompanied pancreatic distomatosis.

In the presence of pancreatic fat necrosis necrosis has also been found in remote organs and tissues. Mathias found fat necrosis in bone marrow. Bendt in the fat capsule of the kidney and Schmorl in the pericardium. All these speak for a hematogenous distribution of the ferments. The symptoms referable to the nervous system which were found in our acute cases are probably to be explained upon the same basis.

Bergmann and Guleke (4) consider that the severe general symptoms which accompany fat necrosis of the pancreas are due to resorbed ferments. It is true that the *barriere hemoencephalique* is not permeable to all substances which circulate in the blood still spinal cord lesions in pernicious anemia would suggest that such lipolytic or lecithinolytic agents can get through this *barriere*.

We wish to raise but one more point in the discussion of the effects of the retention of pancreatic secretion namely the relation of the resorbed secretion to metabolism. In all our cases of extreme dilatation of the duct system cachexia was marked. In some of the cases the associated diabetes or tuberculo is may explain this cachexia. Nevertheless it has been reported particularly by surgeons that in cysts of the pancreas emaciation is marked. Extreme dilatation of the pancreatic duct system seems to bring about the same condition. These extreme dilatations may be present without diabetes. There are likewise occasions when duct obstruction may be followed by diabetes.

Endocrinologists regard one type of obesity as being of pancreatic origin. Talta (9) believes that such obesity is connected in some way with the islands of Langerhans. How stasis of pancreatic juice can bring about alterations or changes responsible for pancreatic obesity is a matter for further investigation.

SUMMARY

Acute retention of pancreatic secretion may bring about histological changes in the pancreas. These changes consist of the dilatation of ducts and end chambers and the flattening of the cells in the glands. When such changes take place necrosis may also result. Another effect may be an increase in the size of the islands of Langerhans. An acute stasis of pancreatic secretion may have the same effect upon the islands of Langerhans as would a chronic stasis. Catarrhal inflammations of the papilla of Vater are regarded as a cause of acute stasis of pancreatic juice.

Chronic retention of pancreatic juice is due to permanent alterations in the papilla of Vater or within the pancreas itself. Changes in the papilla of Vater are in most instances caused by the passage or impaction of a gall stone. Scar formations and abnormal duct communications arising from decubital ulcers may then result.

Shrinkage or obliteration of the outlet of the duct of Wirsung may cause a rebuilding of the pancreatic duct system. An adequate compensatory dilatation of the duct of Santorini may or may not take place.

The retention of pancreatic juice may also be caused by benign and malignant tumors of the papilla of Vater.

Chronic inflammatory processes syphilis, tuberculosis and tumor formation in the pancreas may also cause the retention of pancreatic secretion and so be responsible for changes in the pancreas.

Lipomatosis of the pancreas may follow the chronic retention of pancreatic secretion. In such cases the lipomatosis results from fat replacement of necrotic areas.

Chronic retention of pancreatic juice may also apparently have some effect upon the blood. One case of pernicious anemia associated with chronic pancreatitis is reported.

The escape of pancreatic juice into the circulation may be responsible for some changes in the nervous system.

Chronic alterations in the flow of pancreatic secretion produce metabolic changes. Extreme dilatation of pancreatic ducts may bring about the same metabolic changes as do

pancreatic cysts, namely emaciation. The contrary of this condition is pancreatic obesity. Ascending inflammatory processes in the pancreas following stasis of pancreatic secretion play an important role in the etiology of many cases of diabetes mellitus.

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PRIMARY CARCINOMA OF THE FALLOPIAN TUBES ASSOCIATED WITH TUBERCULOSIS

WILLIAM I. CALLAHAN, M.D., HANCOCK SCHULTZ, B.A., M.D.
D. C. ALEXANDER HILLEWIC, M.D., WICHITA, KAN. AS

PRIMARY carcinoma of the fallopian tubes is only a comparative rarity. In 1906 Wehler (7) collected 19 cases from the literature and added 4 of his own. Similarly tuberculous salpingitis is not of infrequent occurrence. Greensberg (10) found that in 1 per cent of all gynecological case tuberculo is of the tubes was present. Statistics vary a great deal for different clinics and are misleading unless based upon histological as well as macroscopical examination. However the simultaneous occurrence of primary carcinoma and tuberculosis of the fallopian tubes is exceedingly rare only 6 cases having been reported in the literature up to the present time.

Carcinoma and tuberculo is were also cited in the same organ in according to White (8) in 1 per cent of 180 necropsies. (9) cited cases of this combination in the same organ in the stomach, the intestines, the regional lymph nodes, the esophagus, the larynx, the skin, etc. He summarized 7 cases in which primary carcinoma and tuberculo is were associated in the uterus and adnexa and added 1 case of his own. In 4 of Gray's cases the tubes were involved in 8 the fundus was involved and in 10 the cervix.

Statistics for the occurrence of tuberculo is vary. As already stated Greensberg found tuberculo is of the tubes in 1 per cent of all gynecological case and of all abnormal tubes removed 1 in 1, or 1, per cent were tuberculo is. Williams says 15 per cent of the case of tuberculo is salpingiti are not recognized macroscopically. In Wahl's (6) clinic 5 per cent of the patient had tuberculo is and not one third were recognized at operation.

The diagno is of tuberculo is of the tube is very difficult to make clinically and is often impossible to make without the microscope. The onset of the disease is insidious and there is an absence of distinctive

clinical symptoms. The commonest age period is between 30 and 40 years which corresponds to the period of greatest sexual activity. There is sometimes a predisposition to tuberculosis. Greensberg reports that 2 per cent of the cases show a hereditary tendency while Wahl states 1 in 10 gave a history of antecedent tuberculosis. The lesion is rarely primary in the tubes and the mode of infection may be (1) hematogenous (2) by direct extension from the peritoneum or (3) by an ascending route from the lower genital tract. The last however is uncommon. Kafka (11) regards the site of tubercles in the mucosa and submucosa or the muscularis of the tube as distinguishing the hematogenous and the peritoneal routes of infection. The condition is usually bilateral although it may be unilateral. Of the genital organs the tubes are the most frequently affected, the uterus less frequently and the ovaries still less.

There is pain and tenderness over the lower abdomen which is intensified during the menstrual periods. Baisch (1) reports menstrual disturbances in 50 per cent of cases of tuberculous salpingitis. Norris (16) states that dysmenorrhoea is present in 90 per cent of cases and is usually of the congestive type. It usually commences from 12 to 48 hours before the appearance of the flow. As a rule there is a slight elevation of the evening temperature especially during the menstrual period. There is a secondary anaemia in 80 per cent of cases, the general health is poor and there is loss of weight. A pelvic examination usually reveals induration in the fornices and a fixed cervix, the uterus may be enlarged and is often in retrodisplacement. Usually there are marked adhesions especially between the tubes and ovaries and the adnexa may be either normal in size or greatly enlarged. The inguinal glands may be enlarged. Sterility is the usual result.

because the condition is usually bilateral although the tendency is for the external abdominal ostium of the tubes to remain patent. The insidious onset with a history of pleurisy and enlarged glands and the existence of a primary lesion elsewhere largely eliminates gonococcal and streptococcal salpingitis. A definite diagnosis may sometimes be made from curetted material.

The majority of writers advocate surgical treatment of tuberculous salpingitis but Lindley (6) and others think that medical methods should be used. Dysmenorrhœa is frequently the result of pulmonary tuberculosis probably on account of the poor general condition and this condition must not be confused with tuberculous adnexitis. Again operation may cause the dissemination of the disease. However Patel and Olivier (18) Berkley (3) von Francke (8) Peterson (19) and Polak (20) favor hysterectomy with bilateral salpingo oophorectomy when the patient's general condition does not contraindicate it. Permanent cures with this method are reported in 66 per cent of cases. Norris does not resort to hysterectomies as a rule and only exceptionally removes both ovaries. He contends that in properly selected cases of tuberculous salpingitis the mortality is not greater than in other chronic tubal infections. Peterson thinks that the operative mortality is usually due to errors in judgment particularly failure to estimate the extent of the primary lesion. Adhesions are almost constantly present between the tubes and surrounding tissues and as the gut is very liable to impairment when these are separated fistulae usually develop. Drains also aid in the formation of these very troublesome complications.

Wechsler in 1906 collected reports of 19 cases of primary carcinoma of the fallopian tubes and added 4 of his own. Statistics vary at the different clinics 0.02 per cent of all gynecological admissions at the Johns Hopkins Hospital 0.07 per cent at the Lenox Hill Hospital and 0.31 per cent of all gynecological laparotomies at the Leipzig Hospital proved to be primary carcinoma of the tubes. The age incidence is greatest in the late preclimacteric or the early postclimac-

teric period 66 per cent of the patients being between the ages of 40 and 55 years. Sterility was noted in 37 per cent of the patients and 29 per cent were primiparae. Associated pelvic inflammation was mentioned in only 8 per cent of the series.

The most constant symptoms are pain, discharge and irregular menses. Pain appears early in the course of the disease and is situated in the hypogastric iliac, or lumbar region on the same side as the lesion. It sometimes radiates to the sacrum, lower extremities, rectum or epigastrium. The pain is usually cramp like and may be continuous or intermittent. It is sometimes relieved by a profuse discharge from the vagina. This discharge is usually of a watery and serous nature but may be white or leucorrhœal. At times it has an offensive odor.

The condition occurs most frequently about the time of the menopause and the patient usually complains of metrorrhagia. Menorrhagia, dysmenorrhœa and irregular amenorrhœa may also be present. Wechsler states that there was abdominal enlargement in 15 per cent of cases and that 4 per cent of the patients had noticed the presence of tumors. In 10 per cent of his series there were changes in micturition. Constipation was common and in 20 per cent there was loss of weight.

Physical examination reveals a mass unilateral, bilateral or in the pouch of Douglas the size varying from that of an egg to that of a man's head. It is impossible from this examination to differentiate between it and an ovarian tumor or a chronic inflammatory affection of the tubes. Ascites was present in 10 per cent of this series. The inguinal and supraclavicular glands are rarely found to be enlarged.

The diagnosis was made only once by Falk (5) who made a diagnostic puncture and removed a piece of the tumor tissue.

All but of the cases in this series came to operation. The results were poor partly on account of the insidious onset of the disease and partly because in many instances radical operations were not performed, the uterus or ovaries being left. Often during removal a tube was ruptured and its contents then

escaped into the abdominal cavity. In the series only 6 cases or 1 per cent were reported as having no recurrence 3 or more years after operation.

In primary carcinoma of the tubes associated with tuberculosis the age ranged from 35 to 55 years. The latter is rather interesting when compared with the average age incidence for tuberculous alone which is from 30 to 40 years and for carcinoma alone which is 40 to 55 years. Sterility was present in 5 of 7 cases including the author's case. This condition was not reported in case 1. In one was reported in 5 cases intermenstrual and menstrual neuralgic backache and pain in the lower third of the abdomen. One patient had a falling down feeling of the pelvic organs. In the 6 cases in which the condition was reported the menses were somewhat irregular in all but one. Metrorrhagia is scanty flow with dysmenorrhea or long period of amenorrhea were the commonest symptoms. The leukorrheal discharge was profuse in only one case and moderate in another that is it was present in only 8 per cent of the cases. In Wechsler's series at primary carcinoma a profuse discharge was present in the majority of cases. Constipation was present in 3 cases. The duration of the symptoms ranged from 4 weeks to 10 years. The carcinomatous condition was unilateral in 3 cases being on the right in 2 cases on the left in 1 case bilateral in 1 case and not reported in 1 case. The tuberculous involvement was bilateral in 3 cases on the right in 1 case and not reported in 1 case.

Only early radical operation in these cases more so than in cases in which other organs are involved give any chance of cure. After the carcinoma has reached the deeper layer of the tubal wall the prognosis is very poor. It is even less favorable than in carcinoma of the other genital organs on account of the thinness of the wall. After perforation there is no obstacle to prevent direct extension to the peritoneum. In his case Stuebler found implantation of the tumor on the crochets of the uterus, intestine and omentum. After the tumor has reached the loose tissue of the broad ligament the propagation of the tumor will follow the

lymph channel in two directions first to the superior lumbar and inguinal gland in the same way as the carcinoma of the corpus uteri second to the external iliac hypogastric and sacral glands as in carcinoma of the cervix. Where the course of these cases was reported it was fatal in all save the authors case.

The following list includes abstracts of all cases of primary carcinoma of the tubes associated with tuberculosis which have been reported in the literature. These were taken in part from Wechsler's monograph.

CASE 1. Von Franke (7) in 1911 reported a case in a woman aged 38. She was married 8 years menses were regular but she had had no pregnancies. Intermenstrual pains started two years before admission and had recently become continuous in the left lower part of the abdomen. Obstipation and vomiting had been present for the past few days. The duration was 2 years. Pelvic examination revealed the presence of a dense tender adnexal tumor bilaterally the uterus was enlarged. The tumor on the left was the size of a goose egg. A panhysterectomy and a bilateral salpingo-oophorectomy were performed. Microscopically the left tube was as thick as a finger and tortuous it was filled with grayish white soft masses there were metastatic nodules on the serosa and the abdominal ostium was closed. The right tube was markedly thickened and the abdominal ostium was closed. Both ovaries appeared normal. There was a fibrinoid of the uterus and metastases to the serosa and intestines. Microscopically there was bilateral tuberculous of the tubes. The middle portion of the left tube showed polymorphous carcinoma. There were a few miliary tubercles in the left ovary. The condition recurred 3 months postoperatively and death followed somewhat later. The tuberculous process was older than the carcinomatous condition.

CASE 2. L. pschutz (3) in 1904 cited a case in a woman 44 years of age. Her menses were irregular and she was sterile. She complained of menstrual backache pains in the left side of the abdomen a falling down feeling and constipation. These symptoms had existed for 1 year. A pelvic examination revealed a nodular fixed retroverted uterus. The adnexa were not definitely palpable. A panhysterectomy and a part of left oophorectomy were done. Microscopically the right tube showed a tumor the size of a hazelnut containing reddish fluid and crumbly soft tumor tissue. The abdominal ostium was closed. The left tube was normal. There were uterine myomata and some metastases. Microscopically the condition revealed a right tuberculous salpingitis and a papillary atypical carcinoma. The patient was again operated upon 6 months later. The ultimate course was not

reported. Here again the tuberculous process was older than the carcinoma.

CASE 3. Barret () in 1915 reported the case of a married woman 46 years of age who was sterile. She had had pain in the right iliac fossa for 10 years. A pelvic examination revealed a hard tumor on the right side which filled the pouch of Douglas and both lateral fornices. A panhysterectomy and a bilateral salpingectomy were done. The right tube was extensively tuberculous. The left tube was also tuberculous and in addition there was a carcinomatous growth toward the outer end. Microscopically the condition was one of squamous cell carcinoma of the left tube with extensive keratinization and bilateral tuberculous of the tubes. The outcome of this case was not given.

CASE 4. Lisperance (1) in 191 reported a case in a woman 35 years of age. She had had irregular metrorrhagia for 4 weeks, also leucorrhoea and some loss of weight. The uterus was fixed irregular and enlarged. The adnexa were not felt. Curettage showed an atypical pleomorphic carcinoma. The uterus and tubes were removed. The right tube was greatly thickened and the fimbria fused. Irregular papillary projections arose from the mucosa and occluded the lumen. There was a left pyosalpinx and small uterine fibroid. Microscopic examination showed bilateral tuberculous salpingitis, papillary carcinoma of the right tube with epidermoidization and metastases in the uterus involving the mucosa. The outcome was not reported.

CASE 5. Stuebler (5) in 193 cited a case in a married woman aged 38. She was sterile and had scanty and painful menstruation. The symptoms were profuse vaginal discharge, recent abdominal pain, obstipation and dysuria. There was a tumor the size of a child's head to the right of the uterus. A bilateral salpingo-oophorectomy was done. The right tube was found to be composed of an inner sausage shaped portion and an outer cystic portion; the latter was filled with caseous material and a projecting papillary structure. The left tube showed a tuberculous salpingitis with serosal metastases. There were also metastases in the uterine serosa and in the omentum. The diagnosis was papillary alveolar carcinoma of the right tube and bilateral tuberculous of the tubes. Metastases had already taken place in the ovary, uterus, omentum and lymph glands along the aorta.

CASE 6. Wechsler in 196 reported a case in a woman 5 years of age. She was admitted to the hospital with a diagnosis of bilateral dermoid cysts. The symptoms and type of operation performed were not given. Macroscopically the specimen consisted of a fallopian tube with an underlying cyst, a tumor and an intraligamentous cystic tumor. The pathological diagnosis was papillary cystadenoma of the fallopian tube associated with tuberculous secondary carcinoma and tuberculous of the broad ligament. The side on which the lesion occurred and the outcome of the case were not given.

The authors' case was as follows:

Mrs. A. I., aged 42, white, entered the hospital August 18, 1925. Her family and past history were not significant. Menstruation had always been regular up to the past year. The menarche took place at 11 years; the interval was 28 days and the flow lasted for 3 days. There was no dysmenorrhea and the flow was of normal amount. For the past 3 years the flow has decreased in amount but otherwise there had been no change until the present year during which there had been only periods. The patient had been married 18 years but had not been pregnant.

Four years before she had begun to have sacral backaches; recently these had become more severe. Four weeks before admission she had noticed a small mass in the right side. This mass was somewhat tender but there had been very little pain in this region. There had been a slight vaginal discharge at times but this did not seem to have any relation to the pain. The patient had had an occasional frontal headache and had had frequency of urination most of her life. Her appetite was good; there was no gastric distress and no loss of weight. She was not constipated. At no time had she noticed a cough, shortness of breath, expectoration or pain in the chest.

August 18, 1925. The general condition of the patient was good. She was ambulatory, appeared 5 years younger than she actually was and seemed quite comfortable as she sat in a chair. Her chest showed good and equal expansion, vocal and tactile fremitus was normal, the percussion note was resonant and the breath sounds were clear with no rales. The cardiovascular system was normal; the systolic blood pressure was 120, the diastolic 66. The blood count was normal. The abdomen was rotund and symmetrical. There was a palpable tender mass in the right lower quadrant about the size of a plum. There was no rigidity, no tympanites and no ascites. A bimanual vaginal examination revealed a small cervix of practically normal consistency, the fundus was enlarged, firm, retroflexed and fixed. Attempts to move it caused marked pain. There was a large sausage shaped mass on the right side extending into the pouch of Douglas and on the left there was a smaller, round, tender mass in the fornix. Neither mass seemed to be connected with the uterus. The urinalysis was normal. A tentative diagnosis of bilateral hydrosalpinx and fibromyoma of the uterus was made.

Operation. A suprapubic incision 10 centimeters long was made. The pelvis was found to be filled with a large pear shaped mass on the right and a smaller cylindrical mass on the left, the whole being only slightly adherent to the gut and parietal peritoneum. The adhesions were broken down and the tubes exposed throughout. A bilateral salpingectomy was performed. Our pathologist then sectioned the tubes and reported that a seropurulent fluid exuded and that the lateral thirds of both



Fig. 1. Section of the fallopian tube and uterus. The fallopian tube is shown in the center, with the uterus on either side. The fallopian tube is labeled 'f' and the uterus is labeled 'u'. The fallopian tube is shown in cross-section, revealing the internal structure. The uterus is shown in longitudinal section, revealing the internal cavity. The fallopian tube is shown in cross-section, revealing the internal structure. The uterus is shown in longitudinal section, revealing the internal cavity.

tubes revealed soft papillary growths which were diagnosed as carcinoma. Following the operation a panhysterectomy and a bilateral oophorectomy were done together with the removal of the broad ligament. On the right side a drain was inserted and the wound closed in layers in the usual manner.

Pathologic Findings. The mass from the right side of the uterus in the enormously enlarged broad ligament. It had the shape of a large cylinder measuring 5 centimeters in diameter and 16.5 centimeters in length. The external surface is smooth and of a light color. It feels very tense as if filled with fluid. The medial end of the cylinder tapers into a thickened end tubal all centimeters in diameter. The large rounded lateral part represents the omentum. The flattened end of the tube. The cavity of the tumor is filled with 380 cubic centimeters of serous purulent fluid of greenish yellow color. The larger part of the wall is thin (3 millimeters). Its inner surface is covered with friable ragged villous caseous like material. The distal third of the cavity is filled with very soft oedematous papillary grayish masses which are found to be adherent to the wall.

The left tube is much smaller and more spherical. Its diameter is 4 centimeters. The wall is thicker the surface is covered by adhesions. The abdominal stium is bilaterally. The isthmus part is of normal size 3 centimeters long. The contents of the sac are saline like and grayish brown. The ampullary part is filled with the same papillary oedematous gray tissue as in the tumor of the right side. The body of the uterus is of normal size. In the endometrium a few small gray tubercles are encountered.

Microscopic Findings. Sections through the isthmus part of the right tube (Fig. 1) show a narrow lumen throughout. It is lined by one layer of high epithelial cells darkly stained nuclei. A single tubercle consisting of lymphocytes epithelial cells and on giant cells. The lymphocytes type found directly beneath the epithelium. The wall is thick and fibrous but without fresh inflammatory changes.



Fig. 2. Section of the fallopian tube in the isthmus part of the fallopian tube.

Sections through the medial part of the cystic tumor reveal a long standing tuberculous process. The folds of the tube are flattened and adherent. Pseudocystic spaces are present and lined by columnar or cubical epithelium. In some sections these gland like spaces are reaching the muscle layer but not invading it which shows that the infection was probably hematogenous and did not occur by direct extension from the peritoneum. Many typical tubercles are seen lying close to these pseudocystic spaces.

Sections through the lateral part of the tumor (Fig. 3) show a papillary growth protruding from the cyst wall into the lumen. The tumor is composed of fine strands of connective tissue with dilated blood vessels and large epithelial cells of varying size and staining quality. Some mitotic figures are seen. In most parts of the tumor these epithelial cells are arranged in small alveoli some areas show a more solid structure. In other sections a simple papillary arrangement is seen. In the stroma of the growth a few fresh tubercles are found.

Nowhere can the origin of the tumor be traced to the atypical gland like spaces caused by tuberculous inflammation. As Figure 3 clearly shows the neoplasm originated directly from the normal epithelial layer. The deeper layers of the cyst wall show only chronic inflammatory changes and infiltration by lymphocytes but no invasion by tumor cells.

The sections of the left tube (Figs. 5, 6 and 7) present the same carcinomatous and tuberculous changes as in the right tube only there are larger areas of caseation in the tubal wall. Sections through the uterus (Fig. 4) reveal many fresh tubercles with giant cells in the endometrium without caseation. Figure 1 shows the relative sites from which the sections were taken. A diagnosis of bilateral papillary adenocarcinoma and tuberculosis of the fallopian tubes and tuberculosis of the uterus was made.



Fig 3 Papillary alveolar carcinoma of the right fallopian tube

After the microscopical report was received a roentgenogram (Fig 8) of the chest was made. The heart and mediastinum were normal, the pleural angles were clear and there were some small calcareous glands in the hilus of both lungs and much infiltration in and about the hilus of the right lung and to a lesser extent in the hilus of the left lung. There was peribronchial infiltration extending down the right bronchus to the point where it approaches the diaphragm. There the pleura of the right lung was adherent to the diaphragm. The picture suggested hilus tuberculosis probably in active. This was presumably the primary source of the tuberculous infection.

The patient had a very satisfactory convalescence, the only discouraging feature being a fistula at the distal end of the wound which led to the intestines. She received deep roentgen ray therapy from time to time. At present 2 years and 3 months after operation the patient's general health is good, her only discomfort being caused by the presence of the fistula. This is no doubt a tuberculous fistula and it heals and breaks down intermittently. However, the patient manages her household and social duties quite easily and is quite contented.

The following are cases of secondary carcinoma of the fallopian tubes associated with tuberculosis. This condition is also rare.

CASE 1. Stein (24) in 1933 reported a case of a virgin aged 48. The thoracic organs were normal, the primary carcinoma was in the uterus. Macroscopically the right tube showed old caseous tuberculosis and the fundus of the uterus was



Fig 4 Tubercles in the endometrium of the fundus of the uterus

degenerated. Grayish yellow nodules were situated in the walls. Microscopically in the walls of the tubes and uterus were many caseous epithelioid and giant cell tubercles surrounded by strands of large flat chromatin rich cells in which glandular formation was noted. The diagnosis was squamous cell carcinoma primary *in situ* and metastasizing in the tubes associated with tuberculosis. Stein thought that the tuberculosis was the older process.

CASE 2. D Hallum and Delval (4) cited a case of a woman aged 35. It was impossible to determine which was the cavity or to determine the demarcation between the uterus and the adnexa. Microscopically the specimen showed a cylindrical cell carcinoma of the corpus uteri and the tubes. Many tubercles were found between the carcinomatous columns.

CASE 3. Stacy and Nelson (23) reported the case of a woman aged 39 who had had no children. Operation revealed a left papillary carcinoma of the tube and ovary. Both tubes were tuberculous. As carcinoma is of more frequent occurrence in the ovary, this was classed as secondary in the tube.

An interesting case was reported by Montgomery (15) in which a cylindrical cell carcinoma of the right tube was associated with a tuberculoma of the left tube. This shows the coexistence of these conditions without any relationship between them.

The problem which interested most of the previous observers was the etiological relationship between these two pathological processes. Is it true that one process causes the other and is therefore primary, or are the processes found only accidentally in the same organ and have no influence on each other?



Fig. 5. Photomicrograph showing the fallopian tube in cross section. The tube is filled with inflammatory cells and is surrounded by a thick wall.

A number of the reported cases our pathological findings suggest that the inflammatory process anteceded the neoplastic growth. There were free tubercle without cavitation or fibrosis even in the carcinoma itself but from the sterility of the patient the obliteration of the abdominal ostium from the extensive cavitation in many areas and from histological changes as seen in Figure 5 and 6 we are forced to believe that we are also dealing in our case with a long standing inflammatory process. From this fact most of the investigators conclude that there is a direct relationship between both lesions. Von Franque who described the first of these cases thought that the tuberculo had caused a proliferative reaction of the glandular epithelium which had overstepped the normal boundaries and developed into a carcinoma. In cases of uncomplicated tuberculo of the tube he and others found adenomatous proliferation which invaded the wall and far the muscle layer but did not penetrate the peritoneal membrane and which often were difficult to distinguish from true carcinoma. The proliferation of the mucosa are not peculiar to tuberculo. They are found also in other inflammatory conditions of the tube (Stein). We see the



Fig. 6. Photomicrograph showing the fallopian tube in cross section. The tube is filled with inflammatory cells and is surrounded by a thick wall.

same proliferative changes in the uterus in cases of so called adenomyosis also in other organs for instance in the intestines and the gall bladder the picture are not unknown.

Whether the inflammatory process which often is seen associated with carcinoma of the fallopian tubes is tuberculous or not is generally conceded by most pathologists to be more difficult to diagnose than a carcinomatous condition associated with tuberculo. It is not necessary for metastases to occur before a diagnosis of carcinoma can be made. In the majority of cases as also in the authors it has been impossible to demonstrate the tubercle bacilli. This fact makes it still more difficult to make the diagnosis of tuberculo and yet an experienced pathologist should also be able to do this.

Orthmann (17) believed there was an etiological bearing of the inflammation on the carcinoma. Sanger and Barthly stress on the fact that chronic inflammation is encountered very often in cases of tubal carcinoma. According to the so called theory of Sanger and Barthly the primary carcinoma of the tubes is added to a chronic salpingitis which serves as a predisposing factor. There is no doubt that many of the cases of primary carcinoma of the tube are observed in chronically inflamed organs. In Wechsler's series a localized inflammatory change was reported in only 8 per cent of the cases. However if a more careful history had been



Fig. Carcinoma of the left fallopian tube

obtained the percentage might have been found to be higher.

We are in accord with Stuebler and Zuciling in believing that the inflammatory changes can be regarded as the cause of carcinoma first because they are so very common in the tubes as compared with the occurrence of primary carcinoma and second because the histogenesis of the carcinoma does not support the theory of Saenger and Barth. Von Franqu has already shown that the carcinoma does not originate at the places where the atypical proliferation caused by tuberculosis predominates but that it grows directly from the normal epithelium. Our Figure 3 illustrates this point. Ribbert (1) is right when he says: "We are not justified in claiming that the tuberculosis prepares the field for carcinoma and creates the disposition for it, as long as tuberculosis does not make pathological changes just on the same place where the carcinoma originates."

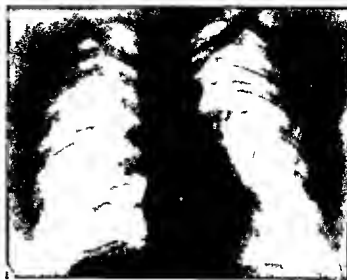


Fig. 8 Ioenigenogram of the thorax. It is suggestive of inactive foci of tuberculosis.

Lubarsch (14) believes that the carcinoma may be caused by the repeated chemical irritation of the epithelium by the excretion of the tubercle bacilli and their toxins. However, the infrequency of primary tubal carcinoma as compared with that of tuberculous salpingitis speaks against this explanation. Montgomery's case in which carcinoma occurred in one tube and tuberculosis in the other also opposes this theory.

Let us consider briefly the histology of the tumor. Saenger and Barth made a clear distinction between the primary tubal carcinoma of the papillary and of the alveolar type. In our case papillary areas were found to vary with alveolar structure. It seems that the early carcinoma represents the papillary form and that in later stages the alveolar character prevails. Both may be regarded as different developmental stages of the same tumor. This variety in structure is seen also in tumors of other organs, as in the malignant papillary cystadenoma of the ovary where solid masses often are encountered. Also the metaplastic changes in primary carcinoma of the tubes into squamous epithelium (Orthmann-Amreich) suggest a mutability of the tumor. We believe that our case represents an early stage of the neoplastic process not only on account of the prevailing papillary structure but also because the deeper layers of the tubal wall are little invaded by tumor cells. Both ovaries and the broad ligament

were found free from tumor and there were no implantations on the serosa of the tubes or of the uterus

SUMMARY AND CONCLUSIONS

1 Primary carcinoma of the fallopian tubes has been reported in 196 cases. Tuberculosis occurs in 1 per cent of all gynecological cases but the combination of primary carcinoma of the tubes associated with tuberculosis of the tubes has been reported only 6 times the authors case making the seventh.

Secondary carcinoma of the tubes associated with tuberculosis is also extremely rare.

3 The signs and symptoms of these conditions alone and in combination have been discussed.

4 The clinical diagnosis of tuberculosis of the tubes is very difficult to make.

5 The pathological diagnosis of primary carcinoma of the tubes associated with tuberculosis must not be confused with the atypical carcinoma like proliferation which is so common in tuberculous salpingitis.

6 Extreme care must be exercised in making a pathological diagnosis so as not to confuse some of the inflammatory processes occurring in carcinoma of the tubes with tuberculosis.

7 The consensus of opinion regarding the etiology of these conditions is that the one is an accidental complication of the other and although the tuberculous process is usually the older it can not be proved that it is the cause of the carcinoma.

8 One case was reported of a primary carcinoma of the right tube and tuberculosis of the left tube.

9 The prognosis is unfavorable. Early radical operation is the only treatment which offers any success.

10 After years the authors patient showed no metastases and was in good health with the exception of the presence of a fistula.

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SYPHILIS OF THE STOMACH

WITH SPECIAL REFERENCE TO ITS INCIDENCE¹

HARRY A. SINGER, M.D., CHICAGO

Att. d. g. Phy. Cook C. tyll. pl. I

AND

KARL A. MYER, M.D., F.A.C.S., CHICAGO

Att. d. g. s. g. C. k. C. tyll. pl. I

JUDGING from postmortem statistics and the opinions of morbid anatomists syphilis of the stomach is of exceedingly rare occurrence. In spite of the enormous number of autopsies which have been performed throughout the world only a handful of examples of acquired gastric lues have been reported from the morgue. Most pathologists especially those of limited experience apparently have never encountered syphilis of the stomach at the autopsy table. However even those who have had access to an abundance of material and have made a special search can lay claim to but few personal observations of gastric lues. According to Gmelin (11) the late E. Fraenkel during more than 40 years' service as pathologist to one of the largest hospitals in Germany saw only 4 cases of syphilis of the stomach. In the last 10,000 necropsies at the same hospital (Hamburg-Eppendorf) not a single instance of luetic stomach was seen. Turnbull (21) in 3,000 postmortems at the London Hospital failed to encounter any specific gastric lesion except perhaps in one instance. Symmers (20) at Bellevue Hospital, New York, in a study based upon 4,880 autopsies found among 314 syphilistics only 1 case of gastric involvement of a specific nature.

The rarity of the affection as indicated by necropsy statistics contrasts strikingly with the relative frequency with which syphilis of the stomach is diagnosed clinically particularly since the advent of the use of the Wassermann reaction and the X-ray. Hausmann (13) in his latest report on the subject cited 8 cases observed by him between the years 1914 and 1924 in which the question of gastric syphilis arose. On the basis of clinical and laboratory data he concluded that luetic lesions were present in the stomachs of

3. In his fourth publication on the subject Linhorn (7) described 7 cases of gastric lues the diagnosis in each instance being based entirely upon clinical and laboratory evidence. Recently Bockus and Bank (4) reported the results of their studies on 23 patients with syphilis gastric symptoms and evidence of pathological organic changes observed within a period of 3 years. Six of them presented the accepted clinical criteria necessary to the diagnosis of gastroduodenal syphilis. In 7 other instances the syphilitic factor probably played some part in the clinical picture presented. In the 10 remaining cases the presence of syphilis was only an incidental factor. Of 7,545 patients affected with all types of dyspepsia Smithies (19) determined by clinical and laboratory methods that in 26 syphilitic lesions of the stomach were present. In 1915 Downes and LeWald (6) reported 8 cases of gastric lues diagnosed and treated within a period of 2 years. In 1917 LeWald (17) published his "Further Studies Based on Nineteen Cases" and in 1913 the same author reported on 30 instances which he recognized by clinical and laboratory methods and stated were without doubt true cases of congenital or acquired syphilis. Lusterman (8) in 1917 described 23 clinical cases of gastric syphilis and in the following year (9) was able to add 17 more. In addition to the large groups cited the literature abounds with individual cases or small series in which the diagnosis of gastric syphilis was made on clinical grounds.

The wide discrepancy between the number of clinical and postmortem reports is accounted for partly by the fact that the clinical diagnosis of gastric syphilis is frequently made in the absence of convincing evidence and in the final analysis proves to be incor-

rect. The lack of circumspection manifested in connection with many cases is illustrated in not a few reports in which the diagnosis is based upon the presence of an upper abdominal complaint. X-ray evidence of gastric disease and a positive Wassermann. Critical review indicates that a large proportion perhaps a majority of the cases reported as example of syphilis of the stomach in which the diagnosis was made clinically represent other than luetic lesion.

Elimination of those cases in which the diagnosis rests upon a weak foundation leave a large group in which gastric lues is the only explanation of the clinical picture which can be reasonably entertained. There are cases exemplified for instance in a patient with gastric symptom, a palpable mass manifest syphilis including a positive Wassermann and a typical X-ray deformity who after all other measures have failed obtains decisive and permanent relief following anti-luetic treatment. Furthermore concomitant with the subjective improvement there occurs from the objective standpoint disappearance of the palpable mass and restoration of the normal gastric outline as determined roentgenographically. In such an instance is this hypothetical one it is difficult to discover any explanation which is more plausible than a syphilitic involvement of the stomach. Nevertheless experience has shown that in the face of almost incontrovertible clinical evidence the autopsy may fail to disclose a lesion which the pathologist considers luetic in origin. On this account and because of the rarity with which the disease is encountered at the postmortem table pathologists in general and some of the more skeptical clinicians for instance Boas (3) and Albini (1) conclude that the diagnosis of syphilis of the stomach should not be accepted without definite microscopic evidence. Therefore in order to determine conclusively the incidence of gastric lues it becomes necessary to compare the revelations of biopsies with those of necropsy.

Our interest was directed to the subject of gastric syphilis in 19 when one of us (K. A. M.) encountered at operation a classical example which was reported in collaboration

with Brams (5) the following year. Since that time we have observed and studied 5 other cases treated by gastric resection 1 reported by Singer and Dyas (18) and 2 to be described presently. During the time in which these 4 cases were encountered *intravital* a careful search was made for syphilis of the stomach in our autopsy material. Changes indicative of lues such as were found in the resected specimens were entirely lacking in the 5000 necropsies performed during the same period although almost 10 per cent of the bodies showed evidence of extra gastric lues. On the basis of our own experience we gained the impression that syphilis of the stomach in a microscopically recognizable form appears more frequently at the surgical than at the autopsy table.

After consulting the literature it became apparent that our personal experience in regard to the relative frequency of gastric syphilis in cases in which the diagnosis was confirmed by histological examination was not unique. We observed that with the more frequent resort to gastric resection the number of cases of proved syphilis of the stomach increased almost proportionately. In addition to the many reports of single cases in which the pathological description justifies acceptance of the diagnosis of gastric lues there are series with 2 (Hayem 14 and Gmelin 11) 3 (Gaebert 10) and even 4 cases (Aoyama 2) observed within short period of time. The microscopic evidence in these cases is as trustworthy and as significant as that obtained from postmortem material.

In addition to the references already cited there are many reports in which larger series of cases are operated upon and diagnosed from an anatomical standpoint as gastric syphilis. The cases have not gained acceptance as proved instances of luetic gastritis on account of insufficient or inadequate pathological evidence appearing in print. This applies particularly to those articles in which the clinical or roentgenological aspects are emphasized and the gross and microscopic descriptions are either entirely omitted or treated in a cursory fashion. For instance in Eusterman's (9) report of 40 cases diagnosed on the ground of clinical data operation was

reorted to in 1. No information was given in this or any subsequent report so far as we have been able to ascertain regarding the gross and micro-copic observations. Only brief descriptions accompany the surgically treated cases in the large series of Smithies (19) Trimore (16) and Downs and LeWald (6).

We regard the present situation relating to the incidence of syphilis of the stomach to be analogous to the former status of duodenal ulcer. Before the resort to surgery for benign gastroduodenal lesions became popular duodenal ulcer on the basis of postmortem observations was considered to be an uncommon disease. Even after an abundance of surgical evidence had been adduced in England and the United States to indicate that the incidence of duodenal ulcer was very high continental workers still doubted the correctness of the opinions of Moynihan and Mayo. As late as 1913 Gruber (1) at that time basing his conclusions upon a careful and extensive study of postmortem material warned his clinical associates against being misled by the statistics of English surgeons and stated in his final admonition that duodenal ulcer although more common than previously supposed was still of relatively rare occurrence. It required years of surgical and X-ray demonstration to convince pathologists and skeptical clinicians that duodenal ulcer was exceedingly common and that a large percentage of these lesions healed completely with *restitutio ad integrum* or left indistinct evidence of their former existence.

Since according to our experience and investigations syphilis of the stomach is encountered more frequently at the operating than at the postmortem table it seems reasonable to infer by analogy with the subject of duodenal ulcer that retrogression or healing of gastric ulcers often occurs. It is generally acknowledged that syphilitic lesions throughout the body except in a few locations (aorta, liver) can be identified only during the active stages of the infection. When the evidences of inflammation recede and scar tissue replaces the specific granulations the type of infection as a rule can no longer be determined by histological methods. Therefore with

regard to lesions in the stomach it is reasonable to assume that many of the cases met with in the stage of fibrosis and diagnosed at autopsy as benign pyloric hypertrophy, hour glass stomach and linitis plastica actually represent examples of healing or healed gastric syphilis.

The conclusion based upon the relative frequency of recognizable syphilis of the stomach antemortem and postmortem that gastric ulcers tends to heal and in so doing loses its characteristic anatomic features receives substantial support from the direct study of resected specimens. If a sufficiently large series of cases be examined histologically various changes representing different stages of the infection can be identified. In our combined series which includes 4 resected specimens one encounters in the individual cases different phases of inflammation. In the case reported by Singer and Davis (18) the granulomatous manifestations correspond to those changes seen in general at the height of the disease in the tertiary stage. The lesions in Bruns and Meyers (5) case are also typical of syphilis but apparently represent a later stage of the infection since the plasma cell aggregates noted in the first case are lacking. In the third case of our joint series that of B. C. which is the first of this present report except for a few characteristic fields near the areas of ulceration the changes are practically limited to round cell infiltration and connective tissue production. The fourth specimen (obtained from W. F.) the second of the 2 case reports to follow) shows presumably a still later stage since it is characterized by a dense fibrous overgrowth with widely scattered round cell accumulations. The various phases in the retrogression of the syphilitic infection can be followed not only in a series of separate cases but also though to a lesser degree in different areas of a single specimen as for instance in the first of the cases to be presented below.

REPORT OF CASES

CASE 1. B. C. a woman 38 years of age entered Cook County Hospital on March 16 with an admitting room diagnosis of peptic ulcer. She had been suffering for 2 years from epigastric distress described as a soreness and feeling of fullness perceived

minutely following meals. During the 5 weeks prior to the patient's admission to the hospital the distressing merruor and more persistent On the other hand he sought medical aid Food afforded relief for not taking soda unless belching followed the ingestion of the latter Spontaneous vomiting appeared at the time the epigastric pain became troublesome The emesis which occurred usually at the height of distress following the evening meal would almost invariably after termination aggravation of the pain produce relief The vomitus contained undigested particles of food some of which had been eaten the day previous No blood was noted in either the vomitus or the stool Slight diarrhea was present from the onset of the illness but recently the loss of appetite had become complete The patient had lost approximately 30 pounds during the 5 weeks prior to entrance but a corresponding loss of strength was not manifested No other symptoms referable to the gastro intestinal tract or to other systems were elicited The patient had had two marriages Venereal infection was denied but it was believed that the patient's husband had suffered from a blood disease

Feasted on bread and motor meals showed no free hydrochloric acid. The amount aspirated in hour following an Ewald meal averaged 50 cubic centimeter per hour as 6 hours after the ingestion of the motor meal there was retention of between 300 and 400 cubic centimeters. In the gastric analysis and in the stools occult blood was inconstantly present. Opple Boas bacilli were found in the stomach contents and the test for lactic acid was positive. The blood picture showed a slight degree of secondary anemia. The blood Wassermann was reported plus.

An X-ray examination performed March 20, 1955, showed that only a little of the previous 6-hour meal had passed into the intestinal tract. During screen observation almost negligible amounts of gastric content and practically no peristalsis are noted. The flat films demonstrated a blunt pyloric extremity from the inferior half of which a filament of barium extended 2 centimeters or more to the right. The interpretation of the roentgenologist Dr. C. A. Matthews is that the anastomotic lesion of the pylorus is indistinguishable from a characteristic of neither carcinoma nor peptic ulcer.

A h i r t o u r s e f a n t h u t t r e m e n t f a i l e d t o
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A t t h e p e r a t i n g p e r f o r m e d b y o n e o f u s (J . A . M .)
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t h e d i l a t o r y t h u r l o f t h e s t o m a c h a s e n c o u n t e r e d .
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p h l i c c o u l d n o t b e m a d e d e f i n i t e l y i t w a s d e c i d e d
t h a t a r e t r o s p e c t i v e u n d e r t a k e n . T h e p a t i e n t s p o s t
p e r a t i v e o n d t o n b e c a m e p r o g r e s s i v e l y w o r s e a n d
h i l i e d o n t h e f i l l i n g d a y .

Autopsy examination for the postmortem was limited to an examination of the intra abdominal organs. No evidence of flakage or of peritonitis was

demonstrable. The remaining two thirds of the stomach was free from change and were also the small and large intestines. The liver was shrunk and especially the left lobe where multiple irregular, dark and yellow elastic nodules 1 to 3 centimeters in diameter were found. Although the left lobe and the region of the falciform ligament were principally affected the right lobe was not altogether spared. The yellowish nodules were of irregular outline, firm, opaque of rubber like consistency and oftentimes surrounded by radiating fibrous tissue.

The microscopic examination of several hepatic nodules revealed the following characteristics. The central portion of each nodule was the seat of coagulative necrosis in which faint shadows of the pre-existent structures could be identified. This necrotic portion was surrounded by a zone of fibroblasts, epithelioid and a number of round cells. The outer layer consisted of a young granulation tissue with many capillaries and numerous lymphocytes, lymphoid and plasma cells. The appearance was so typical microscopically that material taken from this liver was and is still being utilized to illustrate for teaching purposes the appearance of a classical hepatic gumma. Sections from other areas in the liver showed the changes usually described in healing or healed gummata.

Stor ach Gross report The surgical specimen submitted to the laboratory was described as follows This specimen consists of a resected distal one third of a stomach measuring 9.5 centimeters in length and an attached portion of beginning duodenum The form of the organ is altered so as to resemble a tubular structure in which the sides corresponding to the greater and lesser curvatures are of almost equal length The serous coat is relatively smooth The lumen of this altered portion of stomach is almost completely obliterated due to thickening of the gastric walls When the specimen is cut along the greater curvature there is seen a number of defects of the lining of the stomach located mainly in the distal half of the specimen where the wall reaches its maximum thickness There are 7 such ulcerations varying in size from 0.5 to 1.2 centimeters These except for differences in size and depth are practically identical The outlines of the ulcer are irregular the edges sharp the walls perpendicular and the floors covered with fibrinous membranes The majority of the ulcers are superficial and limited to the mucous membrane None extend below the mid portion of the submucosa The wall of the deepest ulcer measures 0.7 centimeter

On cross section parallel to the greater curvature of the stomach the proximal end of the specimen is seen to be of relatively normal thickness. In approaching the pyloric sphincter the wall gradually increases in thickness reaching its maximum (1.1 centimeters) at a point 2 centimeters from the beginning of the duodenum where it abruptly ceases. The individual gastric coats can readily be distinguished. The mucosa on the whole appears thinner than normal.



FIG. 1. Case 1. Artery located in the upper third of the ulcer mucosa remote from any point of ulceration. The round cell invasion of the wall of the vein *a* is limited to only a portion of its circumference. The wall of the artery is thickened but free from inflammatory elements. The submucous connective tissue which is rather dense is infiltrated by scattered lymphocytes and lymphoid and plasma cells. $\times 150$.



FIG. 2. Case 1. A section of the submucosa in the neighborhood of an ulcer. The appearance of the vein *a* has been altered greatly by granulomatous involvement that only by means of elastin stains can the structure be identified as that of a blood vessel. The panphlebitis has led to partial destruction of the internal elastic membrane and complete obliteration of the lumen. The arterial element *b* and *c* show slight thickening of the wall and infiltration of the adventitia. Weigert's elastic tissue stain. $\times 150$.

and is intimately attached especially in the regions of ulceration to the underlying layer. The thickening of the gastric wall is due almost entirely to an increase of the submucosa which in places measures 0.7 centimeter. The proliferated tissue is white fibrous and dense except in the proximal portions of the specimen where it is edematous and succulent. In the upper half of the layer are yellowish gray foci some of which appear to be cross sections of thickened blood vessels. The muscularis and serosa are practically unaltered. The lymph glands along both curvatures are slightly enlarged and firm and on cross section are uniformly pinkish gray.

Microscopic description. The histological alterations differ widely in the several sections examined. Active cellular proliferation and infiltration are seen mainly in the regions of ulceration. Peripherally the evidences of recent inflammatory reaction are found to diminish until finally areas of old granulation tissue are encountered. The following is a composite picture of the changes noted in and about the ulcers and also in the individual gastric coats especially at a distance from the ulcers.

Ulcerations. The most superficial of the ulcers affects mainly the gastric pits of the mucous layer whereas the deepest has led to destruction of the upper one third of the greatly thickened submucosa. The most pronounced changes are noted in connection with the deeper ulcers; the description of one of which follows. In approaching the ulcer margin

there is seen a separation of the individual pits and tubules with a corresponding decrease in the number of epithelial elements. Replacing the closely packed glands are fibroblasts and dense collections of lymphoid cells and lymphocytes which become especially numerous at the edge of the defect. The muscularis mucosae due to granulation tissue production and inflammatory cell infiltration is divided into fragments which become widely separated and are finally entirely lost as the border of the ulcer is reached. The wall of the defect which is perpendicular to the surface of the mucosa is lined with a cellular debris rich in chromatin remnants together with a small amount of fibrin. Immediately subjacent is a very thin wall of polymorphonuclear leucocytes resting upon a granulation tissue base made up of closely packed fibroblasts which support dense accumulations of lymphoid cells and lymphocytes. A moderate number of capillaries most of which are compressed by the proliferated and infiltrated cells together with structures which resemble obliterated blood vessels are found in this zone. In passing centrifugally into the surrounding tissues the round cells diminish in number and the granulation tissue becomes more dense and richer in collagen fibers.

Mucosa. In practically all of the sections examined there is a marked diminution in the number of epithelial elements as compared with the normal

During the 5 weeks prior to the hospital admission the patient had persistent On the night of admission Food afforded relief by taking small sips of water. Spontaneous vomiting appeared at the time the epigastric pain troubled him. The emesis which occurred usually at the height of distress following the evening meal would almost invariably after treatment with morphine produce relief. The patient in addition stated particles of food some of which had been eaten the day previous. No blood noted in either the vomitus or the stool. Slight diarrhea was present from the onset of the illness but recently the loss of appetite had become complete. The patient had lost approximately 10 pounds during the 5 weeks prior to entrance but a corresponding loss of strength was not manifested. No other symptoms referable to the gastrointestinal tract or to the systems were elicited. The patient had two marriages. Venereal infection was denied but as believed that the patient's husband had suffered from a blood disease.

The food and motor meals showed no free hydrochloric acid. The amount aspirated an hour following a liquid meal averaged 250 cubic centimeters. In 6 hours after the ingestion of the motor meal there was retention of between 300 and 400 cubic centimeters. In the gastric analysis and in the stool and blood was inconstantly present. Oppler Boas bile were found in the stomach contents and the test for lactic acid was positive. The blood picture showed a slight degree of secondary anemia. The blood Wassermann was reported as plus.

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Stomach. Gross report. The surgical specimen submitted to the laboratory was described as follows. This specimen consists of a resected distal one third of a stomach measuring 9.5 centimeters in length and an attached portion of beginning duodenum. The form of the organ is altered so as to resemble a tubular structure in which the sides corresponding to the greater and lesser curvatures are of almost equal length. The serous coat is relatively smooth. The lumen of this altered portion of stomach is almost completely obliterated due to thickening of the gastric wall. When the specimen is cut along the greater curvature there is seen a number of defects of the lining of the stomach located mainly in the distal half of the specimen where the wall reaches its maximum thickness. There are 7 such ulcerations varying in size from 0.5 to 1.2 centimeters. These except for differences in size and depth are practically identical. The outlines of the ulcers are irregular the edges sharp the walls perpendicular and the floors covered with fibrinous membranes. The majority of the ulcers are superficial and limited to the mucous membrane. None extend below the mid portion of the submucosa. The wall of the deepest ulcer measures 0.7 centimeter.

On cross section parallel to the longitudinal axis of the stomach the proximal end of the specimen is seen to be of relatively normal thickness. In approaching the pyloric sphincter the wall gradually increases in thickness reaching its maximum (1.1 centimeters) at a point a centimeter from the ring. This thickening is maintained to the beginning of the duodenum where it abruptly ceases. The individual gastric coats can readily be distinguished. The mucosa on the whole appears thinner than normal.



Fig. 1. Case 1. An area located in the upper third of the ulmucosa remote from any point of ulceration. The und cell invasion of the wall of the vein *a* is limited to only a portion of its circumference. The wall of the artery *b* thickened but free from inflammatory elements. The submucous connective tissue which is rather dense is infiltrated by scattered lymphocyte and lymphoid and plasma cells. $\times 150$

and is intimately attached especially in the regions of ulceration to the underlying layer. The thickening of the gastric wall is due almost entirely to an increase of the submucosa which in places measures 0.5 centimeter. The proliferated tissue is white fibrous and dense except in the proximal portions of the specimen where it is edematous and succulent. In the upper half of the layer are yellowish gray foci some of which appear to be cross sections of thickened blood vessels. The muscularis and serosa are practically unaltered. The lymph glands along both curvatures are slightly enlarged and firm and on cross section are uniformly pinkish gray.

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Fig. 2. Cross section of the ulmucosa in the neighborhood of an ulcer. The appearance of the vein *a* has been altered greatly by granulomatous involvement that only by means of elastin stains can the structure be identified as that of a blood vessel. The pamphebitis has led to partial destruction of the internal elastic membrane and complete obliteration of the lumen. The arterial elements *b* and *c* show light thickening of the wall and infiltration of the adventitia. Weigert's elastic tissue stain. $\times 150$

there is seen a separation of the individual pits and tubules with a corresponding decrease in the number of epithelial elements. Replacing the closely packed glands are fibroblasts and dense collections of lymphoid cells and lymphocytes which become especially numerous at the edge of the defect. The muscularis mucosae due to granulation tissue production and inflammatory cell infiltration is divided into fragments which become widely separated and are finally entirely lost as the border of the ulcer is reached. The wall of the defect which is perpendicular to the surface of the mucosa is lined with a cellular debris rich in chromatin remnants together with a small amount of fibrin. Immediately subjacent is a very thin wall of polymorphonuclear leucocytes resting upon a granulation tissue base made up of closely packed fibroblasts which support dense accumulations of lymphoid cells and lymphocytes. A moderate number of capillaries most of which are compressed by the proliferated and infiltrated cells together with structures which resemble obliterated blood vessel are found in this zone. In passing centrifugally into the surrounding tissues the round cells diminish in number and the granulation tissue becomes more dense and richer in collagen fibers.

Mucosa. In practically all of the sections examined there is a marked diminution in the number of epithelial elements as compared with the normal

diarrhea which at times alternated with constipation. Pus, blood or mucus were not observed in the stool. Caceous eruptions were frequent and annoying. Venereal disease was denied but the patient's wife had never conceived. Alcohol had been imbibed freely for many years.

The physical examination disclosed an emaciated individual with a sunken abdomen. Tenderness was noted in the epigastric region. No mass was palpable. A test aspiration 2 1/2 hours after an ordinary meal revealed no free acidity. An Ewald test meal aspirated at the end of an hour yielded 100 cubic centimeters, 65 per cent of which consisted of undigested material. It contained 1 degree of combined but no free acidity. The test for chemical blood was negative. Stools showed the persistent presence of occult blood. The blood Wassermann was reported plus. The X-ray showed a demarcated constriction 5 centimeters long located in the proximal portion of the pars media. The deformity produced was of the dumb bell type (Fig. 3).

Although the diagnosis of syphilis was strongly entertained the persistency of the vomiting and the progressive loss of weight while in the hospital rendered immediate operative interference imperative. The patient accordingly was transferred to the surgical service. At the operation performed August 27, 1916 by one of us (K. A. M.) a dense annular constriction of the middle of the stomach was encountered and resected together with the adjoining pyloric portion. The postoperative condition of the patient was considered fair for 3 days after which time however he steadily failed and died on September 1, 1916. Permission for autopsy was refused.

Stomach. Gross report. This specimen consists of a sausage shaped resected distal portion of a stomach measuring 11.5 centimeters in length. The proximal one half is rigid and thick as compared with the remaining portion which is normally thin and pliable. The serous coat is everywhere smooth save for a few fibrous tags near the lesser curvature. In the unopened specimen there is seen a diminution in the caliber of the proximal one half due to encroachment upon the lumen by the thickened wall. When opened (Fig. 4) the narrowed portion of the stomach averages 3 to 4 centimeters in its inside circumference and its wall measures from 1.0 to 1.3 centimeters in thickness.

On cross section of the constricted and thickened proximal one half the individual coats of the gastric wall are readily discerned. The serosa is somewhat thickened and sharply demarcated from the muscularis propria which in turn can easily be distinguished from the overlying layer. Except for the presence of white fibrous septa which extend from the submucosa the muscularis propria is practically unchanged. The most prominent feature in viewing the wall is an enormous increase in thickness of the submucosa which measures on an average of 1 centimeter. The submucous layer is white, glistening and firm except in approaching the distal



Fig. 4. Case 2. Photograph of the gross specimen. The proximal one third is superficially ulcerated except for the preservation of a small island of mucous membrane (indicated by the arrow). The mucosa of the middle third is atrophied, that of the distal third thickened and mammillated. The thickening of the submucosa diminishes in passing toward the pylorus. P.

one half where the tissue becomes edematous. In the superficial one half of this layer are yellowish gray millet seed sized nodules and white cord like structures which appear to be divided thickened blood vessels. The mucosa in the thickened region is in part absent and in part thinned. Toward the pyloric end the thickening gradually decreases to disappear entirely 3 centimeters proximal to the pyloric ring. The remaining portion of the specimen is on cross section relatively normal.

The gastric lining in the proximal one third of the specimen presents a superficial ulceration 3.5 centimeters in diameter which has an irregular outline and a honeycomb appearance. The edges of the ulcer pass almost imperceptibly into the bordering intact mucosa. The floor of the ulcer is covered by a fibrinous network which can readily be removed leaving a smooth surface. At the proximal end of the zone of ulceration is an island of intact mucosa which measures 0.5 centimeter in diameter. In the middle third of the specimen the mucous membrane is thin, very finely granular and intimately adherent to the underlying structures. In the distal one third the mucosa is somewhat thickened, coarsely mammillated and freely movable. No glandular enlargement is noted along either curvature.

Microscopic description. Except for the mucosa only slight differences in the histological picture are noted in sections taken from various portions of the specimen. The description of the stomach in layers follows.

Mucosa. The mucous membrane throughout the proximal two thirds of the specimen is greatly altered. There is a general diminution in the number of epithelial elements affecting mainly the gastric tubules. In some areas only a few atrophied pits separated by broad zones of interglandular tissue remain. In other areas the gastric crypts are

elongated and widened. Occasionally the mouth of a gland is occluded and its lumen distended with mucus. Many of the glandular elements are rich in glycogen and assume the appearance of crypts of Lieberkuhn. The metaplasia into an intestinal type of epithelium is transitional and typically wide at the top. The transitional mucosa proper is for the most part composed of a columnar granular epithelium with upper lining mucous plasma cells together with a number of lymphocytes. Interspersed among the upper lining mucous epithelial cells are a number of small round cells. The bodies near the transitional epithelium and the nuclei of the cells are all in the picture of inflammatory reaction. In many areas the epithelium is derived from the mucosa. The mucosa is thickened and the submucosa is highly vascularized (fig. 5). Only a few round cells are in the tissue.

In the transition from the region near the upper lining epithelium to the lower mucous membrane the limit of the metaplastic portion of the layer is for the most part indistinguishable. The lower mucous membrane is highly cellular and contains a number of plasma cells and polymorphonuclear leukocytes. The mucous membrane is covered by a thin layer of the floor of the stomach. The epithelium of the stomach is composed of granular epithelium in which are many lymphocytes and lymphocytes. A number of plasma cells and polymorphonuclear leukocytes lining the surface of the mucosa. It is in the mesh of the mucous membrane and in the leukocytes.

Mucosa. The architecture of the layer is uniform and a marked alteration in its areas is unbroken but for the most part it is divided by a few tissue ingrowths into small fragments. In the transition from the remaining muscular membrane to the outermost wall and so is separated from the lining of the stomach. The architecture of the layer is uniform and a marked alteration in its areas is unbroken but for the most part it is divided by a few tissue ingrowths into small fragments. In the transition from the remaining muscular membrane to the outermost wall and so is separated from the lining of the stomach.

The thickness of the layer observed in the gross specimen is due to a dense network of connective tissue in the lamina propria. In the thickened part of the upper half there are numerous thickened folds of the vessels, the arterioles being particularly noted. All the coats in the large blood vessels participate in the thickening. The elements in the wall of the stomach are everywhere noted. In the other half of the stomach the thickness of the layer is uniform and a marked alteration in its areas is unbroken but for the most part it is divided by a few tissue ingrowths into small fragments. In the transition from the remaining muscular membrane to the outermost wall and so is separated from the lining of the stomach.

Extensibility. The extensions of the connective tissue from the submucosa serve to

accentuate the septa in the upper portion of the muscular layer. No cellular infiltrations are noted in any portion of this coat. The serosa except for a slight thickening due to connective tissue increase is unchanged.

Levaditi preparations reveal no spirochæta.

COMMENT ON THE TWO REPORTED CASES

In the absence of the *treponema pallidum* and the classical gumma in each of the cases the correctness of the diagnosis of gastric lues might be called into question. It is to be borne in mind however that failure to demonstrate the specific organism or lesion does not militate in the least against the diagnosis. Sinker and Dyas (18) in their analysis of the microscopic criteria of syphilis of the stomach were unable to find a single report in which the presence of the spirochæta of syphilis or a typical *Gummatus ulcus* was unequivocally demonstrated. The conclusion reached was in general that at the time the patient came to operation or to autopsy the nature of an acquired syphilitic infection of the stomach was such as to lack actual proof but to furnish a number of clinical laboratory and anatomical characteristics which collectively justified the diagnosis.

The clinical history in the first case was rather characteristic of lues in that although it bore a close resemblance to the anamnesis of carcinoma the patient was somewhat younger the symptoms were of longer duration and the constitutional manifestations more pronounced than are generally seen in gastric malignancy. From the laboratory and x-ray standpoints the achylia, the atypical roentgenographic appearance and the positive Wassermann reaction all lent support to the diagnosis of syphilis. The presence of hepatic gummata confirmed the serological report and established the fact that the patient harbored a syphilitic infection. The gross appearance of the specimen viz multiple irregular superficial ulcers occurring in a portion of the stomach in which the submucosa was greatly thickened was likewise typical of lues. In the microscopic sections the vascular changes especially the panphlebitis and the gumma of the mucosa were highly characteristic (although not pathognomonic) of gastric syphilis.

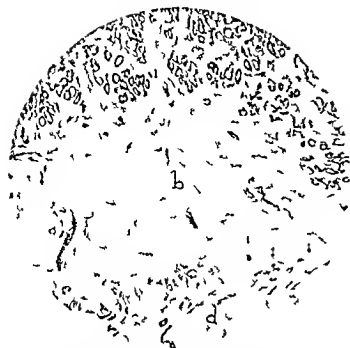


Fig 5 Case 2 Replacing the basal glands of the mucosa. *a* at one edge of the field *a* is a mass of scar tissue *b* representing presumably a healed focus of inflammation. The muscularis mucosae *c* is practically unchanged. Only a small strip of submucosa *d* is included in the photomicrograph. $\times 10$



Fig 6 Case 2 A representative microscopic field from the submucosa. The connective tissue which is old and in places hyalinized supports many thick-walled blood vessels. In addition to a limited number of scattered round cells there are two dense foci, one of which surrounds an obliterated arteriole. $\times 60$

In the second case the microscopic alterations could easily be interpreted as being due to a chronic infection from any one of a variety of causes. The granulation tissue and the vascular changes although compatible with the diagnosis of syphilis were by no means characteristic of the disease. However in view of the history, an achylia, a roentgen ray deformity of the dumb bell type, a positive Wassermann and the typical gross appearance of the lesion the microscopic interpretation of gastric lues in the healing stage appears justifiable.

SUMMARY

According to autopsy statistics and the experience of morbid anatomists syphilis of the stomach is an exceedingly uncommon disease. However judging from clinical reports syphilis of the stomach is not at all rare and is in fact of relatively frequent occurrence. The wide discrepancy between the incidence of gastric syphilis in the clinic and in the morgue is accounted for partly by the fact that many of the clinical diagnoses are based upon insufficient evidence and are obviously incorrect.

However aside from that group in which the diagnosis rests upon doubtful evidence there is a large number of clinical cases in which syphilis of the stomach is the only explanation of the clinical and laboratory observations which can reasonably be entertained. Since syphilis of the stomach is encountered so rarely in the dead house most pathologists and some conservative clinicians demand microscopic evidence before accepting the diagnosis of gastric syphilis. Therefore in order to settle the question of incidence to the satisfaction of all the demand for microscopic evidence must be complied with.

In our own experience at the Cook County Hospital we have been able to demonstrate microscopic changes of syphilis in 4 surgically resected stomachs during a period of 6 years. During the same length of time in approximately 5000 consecutive autopsies at this hospital not a single instance of gastric lues was encountered. The greater frequency of syphilis of the stomach in the operating room as compared with the morgue judging from the literature is a quite universal experience. We regard the present situation relating to

the incidence of syphilis of the stomach to be analogous to the former status of duodenal ulcer. Only after repeated surgical demonstration did pathologists and skeptical clinicians finally subscribe to the idea that duodenal ulcer was far more common than former autopsy statistic indicated.

On the basis of our observations regarding the frequency of gastric syphilis at the operating as compared with the postmortem table we conclude by analogy with duodenal ulcer that retrogression of the syphilitic infection in the stomach frequently occurs. Furthermore we infer that many of the cases diagnosed at autopsy as instances of benign pyloric hypertrophy, hour glass stomach and linitis plastica actually represent cases of gastric syphilis encountered in the healing or healed stage. In support of the assumption that lues of the stomach tends to heal and in so doing loses its characteristic anatomical features is the fact that one can identify in a series of cases what are apparently transitions between the active and the healed stages of the infection. Even in a single specimen different phases of the inflammatory reaction may be encountered.

Two cases are reported in detail. In each the diagnosis is based upon collective evidence including the clinical, X-ray, laboratory and pathologico-anatomical (essential and associated) data.

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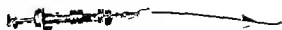


FIG. 3. H. Kel's found with adjustable olive tip.

tour of the border of the uterine cavity (Figs 4, 5). The ostia of the tubes appear pointed (Figs 4, 6, 6a). The cervical canal and the region where it borders on the os internum of the uterus are readily recognized (Fig. 4). A disease change with atrophy of the cervical wall leads to a widening of the canal while the ostium and interstitial portion of the tubes are more distinctly represented. The course of this part of the tube is not always straight and sometimes appears to be spiral apparently because of the influence of the contractions of the bordering musculature. However, one cannot decide with certainty whether this is a spiral course of the tube or just a deceptive appearance caused by muscular contraction. At all events when the tubes are being sounded from the uterus with the aid of a uteroscope, one should on the basis of these findings be careful not to make a false passage.

1. (left) N. 1. on membrane of the tube
1. (right) 1. after the injection of
1. (middle) 1. the tube

year. We have found that elevation of the pelvic angle of inclination of the uterine tube make it possible to obtain highly satisfactory roentgenograms. Contrary to other clinicians we maintain that the cervix should be closed after injection otherwise the iodipin escape to such an extent that the desired effect, the penetration of the iodipin to every angle of the uterus and tubes is not obtained. For the injection we make use of the metal catheter employed by Henkel. This catheter has an adjustable olive tip is flexible and can be handled just as any other uterine sound. In certain instances for example in pregnancy the Henkel catheter is not sufficiently flexible so we make use of the Nelaton catheter which makes it possible to avoid entrance into false passages and the infliction of injuries.

The necessary preliminary preparation of the patient consists first in a thorough general observation and gynecological examination to exclude all fresh inflammatory processes. The uterine canal is thoroughly examined before these investigations are made. Hystero-alpingography is not performed shortly before or after the menses nor when tubal pregnancy is suspected. We have also excluded cases of carcinoma of the uterus because of the danger of transferring and predom. highly virulent cells.

The normal anatomical relations in the region of the uterus and tubes and the reaction to the injection have been studied in detail by means of hystero-alpingography. Figure 4 and 6 show the normal triangular shaped uterine cavity. That the musculature of the uterus has reacted to the injected foreign body is indicated by the fine wavy con-

The generally accepted theory is that the peristaltic movement of the tube is directed toward the uterus. Our examinations have contributed much to the study of this problem. For instance it has been found that when the cavity of the uterus has become filled with iodipin resistance to further injection is immediately felt and the uterus contracts so as to expel the foreign matter. If the cervix has been closed the pressure is directed chiefly against the tube with the result that the fluid overcomes the relatively slight resistance of the uterine ostium of the tube and their interstitial part and reaches the lumen of the tube. The manner in which this occurs can be seen in a series of successive roentgenograms. Ordinarily the pressure in the uterus is not sufficient to force the fluid through the entire tube especially inasmuch as the ampullar end of the tube is but very little widened so that for the further progress of the medium there must be in addition to the uterine pressure an active peristaltic action of the tubes (Fig. 6).



Fig. 4

Fig. 5



Fig. 6



Fig. 6a

Fig. 4 Normal genitalia showing even outline and the pointed ostia of the tube. The 'x' indicates the ostium internum.

Fig. 5 Contraction waves on the left border of the uterus.

Fig. 6 Same uterus a little later showing even outline.

Fig. 6a Normal uterus with pointed elongation of the cornu and distinct widening of the tube toward the ampulla. 'x' Iodipin which has leaked from the tube and scattered diffusely through the abdominal cavity.

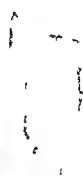
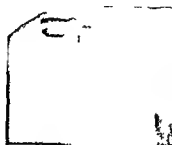
In addition we must expect a certain amount of absorption by the tubes at their uterine ostia when the patient is lying with the pelvis elevated. If a few drops of iodipin are injected into the uterus and the cervix is left open it will be seen that the iodipin finds its way into the tubes. This of course cannot be explained by pressure and peristalsis and must be due to absorption by the tubes. When the iodipin has reached the tube it is carried further by peristaltic action to the ampulla. According to the amount of pressure under which the medium is injected the tube presents either a rather even and straight or wavy and spiral form (Figs. 7, 8, 9, 10). Just as in the known anatomical relations the tube is thinnest at the interstitial end and increases in width toward the ampullar end (Fig. 10). If the medium has passed through the tube it is emptied drop by drop or in larger amounts into the abdominal cavity (Figs. 6a, 11, 13b). In general the peristalsis of the tube is directed toward the abdominal cavity but if the fluid is introduced from the abdominal end of the tube the medium is seen to approach the uterus so that as in the case of the ureter one can also speak of a two way peristaltic action of the tube dependent upon the effect of the stimulus present.

The question of sterility is of great importance. In many cases the cause of sterility can through gynecological examination be traced to certain more or less severe anatomical changes. There may be delicate adhesions linking the tube there may be occlusion of

the abdominal end of the tube or other changes present which at some point obstruct the free passage of the spermatozoa or the ova. By the methods of general examination these abnormalities cannot be readily recognized but by means of roentgenograms the conditions are often clearly demonstrated. Sounding the tubes in these cases does not seem to us the proper procedure because of the possibilities of error and the great danger of making false passages. However because of the fact that these dangers are not encountered in salpingography we have been led to employ roentgenographic methods for the study of these problems.

In testing the patency of the tubes it makes no great difference whether oil or air is used for the principle is the same in either method. Sources of error are met in both methods and the possibility of injury is in our experience not greater with iodipin than with insufflation with air. However we have found that iodipin is more dependable because the results of the examination can be more exactly controlled. With insufflation we control the patency to a certain degree by a characteristic noise which can arise only when the air pressure is great enough to be effective or we recognize the patency by the fact that the plunger of the pressure syringe meets no further resistance. Here one must be certain however that the air does not escape from the uterus through the cervix.

The further advantage of the roentgenographic method rests in the fact that when the medium has reached the tubes the relations



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Fig	Fig
F	No mal g t l a t o g t r o s u e f
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I g	O q u m d m i s s u l v i t e d b t e
t h e l p	f t h n t e e
I g	F l g m e n t o f t h e t y o f t h e t e u d e t
m i t	

in the middle layer through subsequent X-ray control of the peritubal fluid means that the inhibitive effect of diaphragms are not ended at the time of the injection manipulation but only several hours later. By insufflation in the injection, the results are ended at one sitting. Through our cinematographical examination we have come to the conclusion that the results of simple air insufflation are often incorrect. In studies of sterility it is often necessary to have a series of exposures at various time intervals. Indeed immediately after the injection in some cases the clubbing appearance of the abdominal end of the tube indicates occlusion (Fig. 14) but we have repeatedly seen the peritubal fluid and the oil slip into the delicate adhe-

ions so that after several hours the oil makes its way into the free abdominal cavity. In other words, patency has been produced. Of course this can occur in a similar manner by air insufflation, but it is to be considered that a higher primary pressure would be required and that upon discontinuing the pressure the advantage of the peristalsis which we have with iodipin would be lost as there would be a resorption of gas and disappearance of the pressure effect necessary for peristalsis.

If the first picture after the iodine injection shows patency of the tube our position in regard to an existing sterility is clarified otherwise further exposure must be made (Fig. 13, 13c) and according to our experience may extend over 5 days (Fig. 14a).



Fig. 13



Fig. 13a



Fig. 13b



Fig. 13c



Fig. 14



Fig. 14a



Fig. 16



Fig. 15



Fig. 15a



Fig. 17

Fig. 13 Distention of the ampullar end of the right tube with occlusion. The left tube is closed.

Fig. 13a Twenty minute later.

Fig. 13b Six hour later. To the left can be seen the many drop of iodipin which have flowed from the tube. The right ampulla is still well filled. No escape of the contrast medium is yet demonstrable.

Fig. 13c Roentgenogram taken 3 days later. Small shadows can be distinctly seen outside of the area of the large shadow.

Fig. 14 Club shaped occlusion of both tubes.

Fig. 14a Several hours later. Enormous enlargement

of the right ampullar portion is shown. The left ampulla is approximately cherry sized and occlusion is persistent. A diagnosis of sterility due to occlusion of the tube was made.

Fig. 15 Normal triangular form of the uterus and tortuous course of the tubes with widening in the ampullar portion.

Fig. 15a Very much widened ampullar portion of the right tube. The contrast medium is seen flowing from the left tube.

Fig. 16 Uterus bicornis unicollis.

Fig. 17 Uterus bicornis unicollis.



Fig 24



Fig 25



Fig 26



Fig 26a



Fig 27



Fig 28



Fig 29

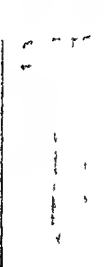


Fig 30

Fig 24 The cavity is displaced to the left and is even in contour. The right tube is tortuous and the left elongated. Diagnosis: left ovarian tumor.

Fig 25 The uterus is displaced to the left and has a small atrophic cavity. The left tube is elongated to the left and upward. Diagnosis: left ovarian tumor.

Fig 26 The cavity of the uterus is completely displaced to the left. The right tube is tortuous and in the middle portion (+) there is considerable widening and then a downward course. The left tube is evenly elongated. Diagnosis: left ovarian tumor.

Fig 26a The cavity of the uterus lies to the left. The left tube is tortuous, the ostium is pointed, the right

interstitial part can not be recognized as it lies behind the right horn. Note the straight course of the right tube. Diagnosis: right ovarian tumor.

Fig 27 The cavity is divided into two parts which are united by a bridge. The left tube is short, threadlike and closed. The right tube is thin and patent. Diagnosis: stasis following conservative myomectomy.

Fig 28 Occlusion of the tubes similar to that in Figure 27.

Fig 29 Occlusion of the tubes similar to that in Figure 27.

Fig 30 A filling defect the size of a grain of wheat in the cervical canal. Diagnosis: polyp of the cervix.

TUMORS OF THE UTERUS AND ADNEXA

Such a purely mechanical viewpoint is refuted by evidence to the contrary. The obstruction of the tube is to be considered as only one of the causes of sterility, even if it is true that patency is an unconditional prerequisite for conception.

The iodipin that remains in the closed tubes or that is emptied into the abdominal cavity (Figs 13a, 14, 15a) is ultimately absorbed in varied lengths of time and does not produce adhesions or serious tissue damage.

The recognition of tumors of the uterus (Figs 18 to 23) and adnexa (Figs 4 to 6) and the estimation of their size and of the extent of the anatomical changes can usually be made by the usual methods of gynecological examination. However, a considerable number of tumor growths on and in the uterus escape recognition by the ordinary technique, and the differentiation of adnexal tumors, especially in the case of smaller growths, may



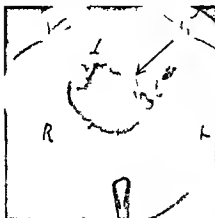
Г 3



Fig 3



FG 33



Г 3.3



Fig. 34



Г 35



1, 36



Г 37

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lead to great difficulties in the ordinary technique of examination. Indeed it is often difficult to decide with certainty whether a mass which is felt to the side of the uterus arises from and is anatomically a part of the uterus or of the adnexa.

The chief uterine tumors are myomata. Often in cases in which atypical bleeding is the most important clinical symptom palpation reveals no abnormality. Nevertheless submucosal myomata and mucous polyps may be present especially in young persons and can be demonstrated by the evidence of filling defects in the hystrogram.

In our clinic it is the policy to perform conservative operations in cases of myomata in order that ovulation and menstruation may be continued. In this connection the uterus has an extraordinary ability for adaptation that is large portions of it can be resected without interrupting menstruation. The results obtained by this procedure of resection of the uterus as recommended by Henkel in numerous publications, are so satisfactory that our goal has been placed still higher. Today we are doing a transverse resection in the middle of the uterus and according to the enlargement of the uterus and the position, size and isolation of the myomata we remove either the anterior or posterior uterine wall so that the remaining portion of the fundus or lateral walls can be sutured over the cervical portion to form a new uterine cavity. The question naturally arises as to what form such a new uterine cavity will assume and whether stricture will occur at some point. Hysterosalpingography now gives us in such cases a clear picture of the newly formed anatomical relations, as shown in Figures 7, 28 and 29. Figures 18, 19, 20, 22 and 23 give a survey of the many possibilities of the changes in form of the uterine cavity in the presence of myomata.

Our attitude with regard to the indications for treatment of myomata of the uterus is plainly dependent upon the position of the myomata and the relation of the tumor to the cavity of the uterus. Curettage of the uterus when a submucosal myoma has been overlooked can become a very dangerous procedure if for technical reasons it is impossible to remove the entire endometrium, as one

would be unable to remove the mucous folds lying behind the myoma. Also there is the danger of opening the capsule of the myoma with the curette and permitting the entrance of infectious bacteria.

If palpation does not reveal definite information then in our opinion a roentgen picture of the uterine cavity is absolutely essential before any operative procedure is attempted. In cases of combined tumors of the uterus and tube it is very difficult to determine by palpation what part of the tumor is the uterus. Here again we are aided in our diagnosis by making a radiogram of the uterine cavity.

Not infrequently, in cases of tumors of the adnexa, it is difficult to decide whether the tumor is essentially caused by disease changes in the tube or whether it arises in the ovary. In a number of such cases a salpingograph will aid in clearing up the situation, especially if the tube is open. That is in fact true for all blastomata of the ovary, whether large or small. It is a known fact as we have repeatedly confirmed in ovarian growths, that with the increase in size of the ovarian tumor the tubes are drawn out in length (Figs. 24, 25, 26). One can make good use of this in interpreting roentgenograms and by comparing the two tubes as shown in the X-ray picture. If a tube through its own defects is elongated as happens in chronic salpingitis, an occlusion is present near the uterus making the filling of the tube impossible. If that is not the case then the anatomical relations of the tube and the uterus can be made out from the enlargement of the shadow in hysterosalpingogram.

It should be distinctly emphasized here that in cases of fresh tubal infections all examinations of the uterus by salpingography are absolutely contra-indicated because of the possibility that injury may be done which should never occur in mere diagnostic manipulations. It is therefore granted that there are certain limitations to our technique but the recognition of these limits is not difficult since the other methods of examination at our disposal are such that the cases contra-indicated for salpingography are readily recognized.

Figures 4 25 and 26 show very plainly the participation of the tube in ovarian tumors. Naturally errors may arise here as in all diagnostic methods of examination but their occurrence will diminish after further study and experience. For example in cases of ovarian tumor with a twisted pedicle one may expect a torsion of the tube as well which will lead to occlusion of the tube at some point. There is the further possibility that we may not be able to discern the shadow of the tube on the film in its entire course because the tumor shadow may be superimposed on that of the tube and may absorb the roentgen rays. Such a case is represented in Figure 6a. However the fact remains that in many cases we can obtain a clear impression of the topographical relations of the organs in the pelvis by this harmless method of examination. We must always proceed from the normal contour of the uterine cavity on the X ray plate and the exit of the tubes.

Polyps of the uterus can be recognized by palpation of the uterine cavity when the cervical canal is open. When the cervical canal is closed we have at our disposal only such methods of examination as the mechanical dilatation of the cervix or trachelotomy preliminary to palpation of the uterine cavity. In making iodipin injections information is obtained in a painless and much simpler manner and we can recognize all but the exceedingly small tumors of the uterine cavity (Figs 18 0 and 30).

THE TEST FOR PREGNANCY

The early diagnosis of pregnancy is often so difficult that in spite of all palpable signs and biological findings one can not always confirm or exclude its presence. We formerly believed that this problem did not belong to the realm of roentgenographic examination but our experiences in several cases in which pregnancy had to be interrupted and in which for scientific reasons we employed our iodipin technique have led us to modify our former attitude because it was found that the act of filling the uterine cavity with iodipin in the early months of pregnancy did not lead to abortion. One case in particular seems to us especially instructive. An attempt at crimi-

nal abortion had been made and it was thought that the end of a hard rubber syringe had broken off and remained fast in the uterine cavity. There were no symptoms of abortion at the time the patient entered the clinic and the cervix was closed. In order to throw some light on the case we carefully filled the uterine cavity with iodipin and then were able to demonstrate on the X ray film the retained piece of syringe.¹ The effect of the iodipin injection was that the syringe tip was lubricated by the oil so that it was later expelled from the uterus spontaneously. The pregnancy proceeded for the time only to terminate later in the desired abortion.

The relations of early pregnancy are such that after the ovum has become embedded in the uterus the uterine cavity as such remains separate from the membranes and decidua. The problem of the technique of uterine injections in these cases is to avoid injury to the decidua. We attain this by the use of a soft Nelaton catheter which we carefully introduce into the cavity of the uterus. The iodipin is allowed to flow with the least possible pressure on the syringe. Pregnancy is then indicated on the roentgenograms by the filling defects in the transformed cavity of the pregnant uterus. Therefore we believe that with sufficient care and in selected cases the hystero-grams can serve the purpose of the early diagnosis of intra uterine pregnancy (Figs 31 to 34).

Whether the method can be employed further for the differential diagnosis between intra uterine and extra uterine pregnancy has not yet been determined but it seems to us that in the differential diagnosis between intra uterine pregnancy and quiescent extra uterine pregnancy this method is commendable. If however disturbances in the development of the extra uterine pregnancy with symptoms of rupture have already set in the possibility exists theoretically at least that hysterosalpingography will result in extending the tears and producing further bleeding. As a rule these cases are not so complicated that this method of examination is an urgent necessity nevertheless this method has enabled us to recognize one case

¹ Ibid. see bed this case. F. H. Ze. tr. bl. f. Gyn. k. p. 8

(Fig. 35) is an extra uterine pregnancy in which there was no clinical indication of its presence and we were able to identify the point of rupture on the roentgenogram. The patient suffered no injury as a result of the examination and several days later operation was performed. No bleeding resulted from the passage of the iodipin through the point of rupture and convalescence was uneventful. However our cases of this type have not been sufficiently numerous to allow final judgment to be made.

GENITAL FISTULA

Fistulae involving the urogenital organs are not uncommon and often it is impossible to follow the course of the fistulous tract and its fine connections by the ordinary means. Here again salpingography has made possible the clear demonstration of the anatomical relations. When a sound is used to explore the often complicated course of the fistulous tract

there is always the possibility of producing false passages and injuries but such is not the case with our technique of examination. We therefore believe that in this field also we have definitely improved our diagnostic and therapeutic means.

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THE NEWER CONCEPTIONS OF SURGERY IN THE DIABETIC¹

JOHN A. REED, A.B., M.D., WASHINGTON

Clinical Assistant, Methodist School of Medicine, Georgetown University

THE prevalence of diabetes, the apparent increase of surgical complications and the need of more united medical and surgical judgment prompt a review of the situation and presentation of the conclusions based on our own and the work of others.

PRE-INSULIN PERIOD

A retrospective view of the surgical diabetes places them in two groups: those prior to and those in the insulin era.

The way of the operative diabetic before the discovery of insulin was hard and paved with inadequate pre-operative treatment and postoperative management, infection, acidosis and coma. A study of twenty different series of surgical patients prior to the advent of insulin shows an average mortality of 34.04 per cent (see Table I). Several of these groups need special comment. Phillips (34) reports two groups, one with a mortality of 36 per cent and another of 17.7 per cent. The first group was untreated pre-operatively while the second was treated with dietetic restrictions before operation and shows a reduction of 50 per cent in the mortality. These two groups frankly show the need and results of treatment of the diabetic patient before submission to surgical procedure. Phillips antedates the present cry of pre-operative antidiabetic treatment by some 25 years. Berkman's low mortality of 7.7 per cent (4) and 5.03 per cent (5) at the Mayo Clinic can be appreciated when we know that he instituted a definite pre-operative regimen for an average period of 15 days, the longest period being 24 days. Further, no emergency surgery was attempted; no operations on gangrenous extremities were performed and local anesthesia was used whenever possible. Ilcher (35) and Bruce (9) report 50 per cent mortality in operations for gangrene while Gardner (19) is still more pessimistic with 80 per cent mortality in the same type. Stetten (38) reports no definite series of cases but

believes that in his early hospital experience every diabetic patient who had a limb amputated succumbed. These high figures of mortality are due to post-anesthetic and post-surgical sequelae rather than to the actual surgical procedure. Of the former, acidotic coma and pneumonia are predominant; of the latter, thrombosis, embolism, cardiac failure and grave asthenia are predominant. As cited by Olmstead (31), the grave asthenia is probably due to an intoxication from an autolysis of stump tissue in amputation without infection, local or general. But the shadow of gloom that overcasts the diabetic through these figures is lifted somewhat when we consider that between 60 and 85 per cent of these deaths due to coma are now preventable and a brighter day for the surgical case arises. Credit is then due to the pre-insulin worker for the suggestion of the dictum of adequate pre-operative diabetic management.

INSULIN ERA

The surgical mortality percentage since the addition of insulin has been reduced and to such an appreciable degree that the more enthusiastic writers (10, 18, 6) conclude that operative procedures in the diabetic are as safe as in the non-diabetic of similar age and physical status and that insulin removes all attendant risks. A study of nine different series (Table II) shows that the average mortality is 1.7 per cent, a figure very much lower than that prevailing before the use of insulin. The highest mortality is still in the group of cases in which amputation has been necessary.

CLINICAL REPORT OF SURGICAL CASES

Of four hundred diabetic cases seen in the last 5 years, surgical intervention was required in 64, a comparatively small number (Table III). In 21 operations was done for the relief of unrelated surgical conditions; in the remainder operation was done for related or

¹ From the Diabetic Clinic of the Georgetown University Hospital, read before the Georgetown University Medical Society, Washington, D.C., May 9, 1935.

TABLE I—PRE INSULIN MORTALITY
STATISTICS

	P e r c e n t
Bruce (41)	30.0
Berkman (4)	7.7
Karewski (51)	14.0
Mason (55)	2.0
Weeden (66)	36.8
Chavannez (4)	40.0
Cumston (45)	16.66
Pilcher (33)	50.0
Noble (59)	24.0
Bruce (6)	20.0
Strause (64)	31.3
Pilcher (46)	48.8
Phillips (34) (amputation)	36.17
Phillips (34) (general)	17.7
Cordner (19) (amputation)	80.0
Cordner (19) (general)	46.0
Tufter (65)	40.0
Meyer (6)	54.6
Berkman (5)	5.03
Fitz (47)	30.0

TABLE II—INSULIN ERA MORTALITY
STATISTICS

	P e r c e n t
Jo lin (23)	11.0
Bruce (41)	2.1
John (49)	8.5
Judd (25)	3.0
Mason (55)	15.0
Weeden (66)	16.6
Cohen (43)	14.0
Pelly (33)	9.6
Coller and Marsh (11) (extremity operations only)	34.0

diabetic surgical conditions In 40 cases general anesthesia was used in 3 local or no anesthesia and in one spinal anesthesia. Fourteen patients were treated locally by medical means such as antiseptics epsom salts and normal saline baths compresses or retention wet bandages heat and light therapy and rest. Of the last mentioned we have considered only those who were sufficiently ill to enter the hospital as we felt that if they were permitted to remain at large life and limb would be endangered. Antidiabetic treatment preceded surgical intervention in every case and a ketogenic antiketogenic balance attained as elicited either by the carbon dioxide volumes per cent of the blood or the absence of ketone bodies in the urine. It is indeed gratifying that only one patient died in the general or unrelated surgical group which is a point in favor of intervention without hesitation in the controlled surgical diabetic. The total mortality of the

TABLE III—SURGICAL INTERVENTION

	N u m b e r	R e c o r d e d	D e a t h s
General surgery			
Cholecystitis	3	3	
Fractures	4	4	
Empyema of pleural cavity	1	1	
Perinephritic abscess	1		1
Appendicitis		2	
Ischio-rectal abscess	1	1	
Ligation superior thyroid arteries	1	1	
Thyroidectomy	1	1	
Tonsillar abscess	1	1	
Carcinoma breast	1	1	
Cellulitis	1	1	
Tonsillectomy	2	2	
Cataract	2	2	
	21	20	1
Related surgery			
Gangrenous extremities	13	8	5
Gangrenous scrotum	1		1
Infected extremities	15	11	4
Ulcers	5	5	
Carbuncles	9	8	1
	43	3	11

group is 18.7 per cent while the mortality of the general surgical group is 4.7 per cent and that of the related surgical cases is 25.5 per cent. The causes of death as determined by clinical laboratory and autopsy findings are shown in Table IV.

PROBLEMS OF THE SURGICAL DIABETIC

When a diagnosis of diabetes is made certain problems arise. In the uncomplicated case these are readily catalogued into an economic readjustment on the part of the patient and the institution of a specific dietetic and insulin regimen tending toward a restoration of disturbed physiology and pathology with a normal balance of blood sugar sugar excretion and weight. In the complicated case for example a superimposed surgical condition the problems are comparatively less readily pigeon holed.

It is an established surgical axiom that the diabetic is a very poor operative risk. This is due in part to the fact that the majority of such patients are old in years (39) and are already in a state of general decline or are prematurely old because of early vessel change. The resistance to infection is low the tissues do not seem to heal and consequently serious diabetic conditions such as coma frequently develop following even minor operations. It

TABLE IV — CAUSES OF DEATH

	C	C
1	phlebotomy	Circulatory failure due to motor paralysis (clinical)
3	(aggressive)	Intestinal edema (probably intestinal — chemical)
4	(aggressive)	Pneumonia (clinical)
6	infected emboli	Septicemia (blood culture positive for hemolytic streptococcus)
8	infected emboli	Septicemia (blood culture positive for hemolytic streptococcus)
9	infected emboli	Septicemia (blood culture positive for hemolytic streptococcus)
	(clinical)	Septicemia (blood culture positive for hemolytic streptococcus)
	(clinical)	Septicemia (blood culture positive for hemolytic streptococcus)

1. probable that some of the conclusions are based on results of operations on the extremities rather than on results of general surgical operations (2)

The introduction of insulin has been a stimulus to renewed interest in several phases of the study of the surgical diabetic such as the co-operation of surgeon and medical attendant the pre-operative treatment the choice of anesthetic and postoperative management

Co-operation. The co-operation of the surgeon and internist should not be extolled as a mere phrase. Concretely the surgeon should know as much about diabetes as the internist with the possible exception of the detail of insulin dosage and diet calculation and conversely the internist should know as much about the surgery of the diabetic as the surgeon with the exception of the actual technique of operative procedure. Delay of consultation and delay of united activity leads only to increased fatality. It has been aptly said that in the case of the diabetic patient who makes equal demands on operator and physician the co-operation of surgeon and internist is the keynote to success.

Pre-operative management. Pre-operative workers have set the pace for the pre-operative treatment of the surgical diabetic. It is true in general that we have two groups of operative cases, those of an emergency nature in which surgery takes precedence and those in which operation is a matter of choice and time permit the formulating and inauguration of a plan of presurgical treatment. However there is no case in which some protective

measures cannot be taken to lessen the too frequent storms in the days that follow the trip to and from the operating room. In the urgent operative case i.e. ruptured appendix there is usually one half to one hour between the time the patient is first seen and the first stroke of the scalpel. It is in this period that the urine obtained by catheterization if necessary may be examined that the blood sugar and volumes per cent of carbon dioxide combining power determinations may be done suitable dosages of insulin and dextrose may be given and even subcutaneous protective saline solution if deemed advisable may be administered. This requires teamwork. If there is no need for such concentrated action that is if operation is a matter of choice many plans have been offered for the pre-operative management of the diabetic. Duncan and Frost (12) suggest a three day preparation with a diet of 100 gram of carbohydrate low in fat content and insulin to bring the blood sugar to a normal level. The hour for operation is set at 9 a.m. At 6 a.m. the carbohydrate content of the usual diet is given plus 10 grams of carbohydrate in the form of orange juice. The usual morning dosage of insulin is given and immediately before the operation an additional dose of 10 to 20 units of insulin is administered. While the patient is still on the operating table 30 to 40 grams of dextrose is given intravenously. Wilder and Adams (40) suggest 100 gram of carbohydrate 3 days prior to operation and usually attempt to bring the blood sugar down to normal but do not give breakfast the morning of the day of operation. Petty and LeFevre (33) bring the blood sugar to its normal level with any necessary known diet and dosage of insulin and continue such management up to one hour before operation using food in liquid form. Jones McKinnick and Root (22) follow similar procedures but do not necessarily attempt to clear the urine of sugar. Others less specifically show the necessity of pre-operative treatment all attempting to accomplish several things: (1) the control of blood sugar level (2) the storage of glucose in the liver (3) the disappearance of ketosis and (4) a sufficient supply of fluid.

Our own pre operative treatment in cases in which operation is a matter of choice does not essentially differ from any of these plans. A diet consisting of a total intake of 100 grams of glucose is given the protein content not to exceed 1 gram per kilogram of body weight and the fat content approximately equal to the amount of glucose taken making no attempt to give a particularly low fat diet—having only a ketogenic antiketogenic balance. Insulin sufficient to metabolize this diet completely is supplied. When the blood sugar has reached the normal level or approximately so when the urine is sugar free and when ketosis is abolished operation may be performed. No specific number of days is set for this preparation. Pre operative purgation is not advised as it may disturb convalescence by the institution of vomiting (1). The preferred time to operate is about 2 hours after breakfast. On the morning of the day of operation the food prescribed is given in liquid form so that the stomach may be empty at the time of operation and the usual amount of insulin administered. No insulin is given just prior to the operation, and no glucose has been given while the patient is still on the table. The giving of fluids just before the operation cannot be too strongly advocated. Pre operative starvation must not be practiced (21). Nixon (30) calls attention to the fact that starvation may cause acetonuria even in the non diabetic.

The anæsthetic. The question of the proper anæsthetic to be used in surgical procedures in diabetics has been discussed so often as to leave little to say. In Table V I have shown the anæsthetic of choice as used by a number of clinicians and surgeons. Chloroform as a general anæsthetic was discarded 30 years ago ether still has its proponents chief of whom are found at the Mayo Clinic (14) where excellent results have been obtained. Nitrous oxide gas stands out pre eminently as a general anæsthetic ethylene is still in the background probably due to its newness and local anæsthesia has a definitely placed use without condemnation. Spinal anæsthesia is considered by some to have an unusual advantage in lower extremity operations (22). In our own work we have used for general

TABLE V—CHOICE OF ANÆSTHETIC

	First Ch	Second Ch e	Third Ch ce	Fourth Ch oc
Foster (16)	gas	ethylene		
Petty (33)	spinal	local	gas	ether
Bruce (9)	gas	local		
Gager (18)	gas	local		
Lewis (54)	spinal	ethylene		
John (49)	gas	local		
Judd (25)	ether	ethylene		
Foster and Davidson (17)	gas	ethylene	local	
Berkman (4)	ether			
Jones (22)	gas	ethylene	local	
Sherrill (63)	gas	local		
Stellen (38)	gas	ether		
Cumston (45)	local	ethylene	ether	
		chloride		
Mohler (57)	gas	ether	local	spinal
Sanders (62)	gas	ethylene	local	
Connell (44)	local	ether		
Strauss (64)	gas			
Labbe (53)	local	ethyl chloride	ether	spinal
		gas		
Roth (61)	local	ether	local	
Plicque (60)	ethyl chloride			
	ether			
King (52)	spinal	ether	local	gas
Murphy (58)	gas			
Jenning (21)	gas			
Christie (10)	gas			
Cohen (43)	gas			
Coller and Marsh (11)	gas	local		
Fitz (14)	local	gas	ether	
Kahn (50)	gas			
Halstead (48)	local	ether		
Mason (55)	gas	local		
Nitrous oxide and oxygen (N_2O-O_2)				
† Ethylene and oxygen ($H_2C=CH-O_2$)				

anæsthesia ethylene and nitrous oxide gas almost to the exclusion of other anæsthetics and we have local anæsthesia in selected cases. Ether has occasionally been introduced after an initial narcosis with ethylene or nitrous oxide to produce greater relaxation at the special request of the operator but the amount used has been kept at a minimum. For both practical and theoretical reasons we have chosen ethylene and nitrous oxide for general anæsthesia, the number of patients suffering from nausea and vomiting too often the exciting cause of postoperative coma, is greatly reduced by their use (29). Theoretically our choice is based on the work of Bloor (7) Leake and Hertzman (27) and others. Bloor found that in experiments on animals ether produced a rise in the fat content of the blood during narcosis and further observed during the anæsthesia a rapid and continuous rise in the fat content of the

blood until death. Such lipæmia predisposes to ketosis. Leake and Hertzman conclude that neither ethylene nor nitrous oxide when used as general anæsthetic agents with oxygen influences the blood reactions so markedly or so rapidly as does ether or chloroform.

POSTOPERATIVE MANAGEMENT

After operation the same meticulous care must be followed. The decline in number of deaths from postoperative coma justifies this statement. The dextrose content of the blood and the carbon dioxide combining power as determined immediately after the operation are the guides to follow in the subsequent administration of food and insulin. Ordinarily if operation is done early in the morning the patient is able to take lunch or an early afternoon feeding. Food as early as possible after the operation is good to relieve the diabetic condition as well as to overcome the usual postoperative nausea and gas distress (2). In nearly all cases the patient may be given food with the carbohydrate content of the usual meal which may be given in liquid form as orange juice. In many cases the full allowance of food even in solid form may be given. Foster and Davidson (17) give large amounts of insulin buffered with glucose until all danger of acidosis has passed. Some (22) measure the insulin dosage on quantitative result from urine examinations made for sugar every 3 hours and give frequent small feedings to avoid overloading the stomach. Petty (33) gives food every 2 hours after operation in the form of liquid carbohydrate by mouth or intravenously while we have not found it necessary to resort to this last measure. Foster (16) religiously advocates and uses an abundance of fluid before operation and after and shows that such use is borne out by experience wherein dehydration alone subjects the diabetic to ketosis and untoward results.

SURGICAL CONSIDERATIONS

A number of questions arise in the consideration of the surgical diabetic chief of which are the healing of wounds, the use of alkalies, the procedure in gangrenous and infected extremities and postoperative infection. The difficulty in wounds healing as one of the rea-

sons for the increased risks involved in surgery in the diabetic has been discussed in the literature from time to time. This surely does not hold true as regards abdominal and other operations except those on the extremities. The failure of stump wounds to heal is due either to infection already present or to tissue autolysis. Otherwise all wounds should heal from first intention since the carbohydrate media should stimulate cell activity (28). As to the use of alkalies as a prophylactic and combative agent against acidosis before and after operation, the older reports abound in its use while at present alkalies are not generally used. In our group no patient received alkalies.

The treatment of gangrenous extremities requires good judgment. In the first place many so called gangrenous extremities are really infections which have caused necrosis of the soft tissue and bone. Such cases require quite different treatment than do cases of gangrene. The classification offered by Coller and Marsh (11) seems very applicable in the establishment of a plan of surgical attack: (1) ulcers, (2) infections of (a) soft tissue (b) osteomyelitis and (c) osteomyelitis with gangrene, (3) primary gangrene (a) without infection and (b) with infection. There is undoubtedly a small group of cases as cited by Gray (20), Dupre (13), Judd (5) and others in which local medical treatment of the affected extremities and general diabetic management suffice to produce the desired results without recourse to drastic amputation; however, the surgeon should be consulted early and one should not wait for that elusive line of demarcation, the shadow line of death. When it has been decided that an extremity must be removed the question arises as to the point at which to amputate. In general it depends upon the extent of the gangrene and the rate of extension, the degree of severity of the disease and the condition of the arterial supply of the part. Risley (36) early laid down certain general rules: if the anterior and posterior tibial and dorsalis pedis arteries have good pulsation, toe amputation may be done if the popliteal pulsation is good, amputation below the knee is done and if popliteal pulsation is absent, high

amputation is advised. Infections after surgery do occur although I do not believe that they are any more frequent than they are in non diabetic patients however once established the prognosis is more grave. Infections of the extremities which manifest themselves after operation undoubtedly were present before surgical procedure and often lead to septicæmia. It can safely be concluded that the arch enemy of the surgical diabetic today is not acidosis and coma but infection and gangrene.

THE FUTURE OF THE SURGICAL DIABETIC

The work of today will influence the future well being of diabetics and their surgical complications. It is undoubtedly true that over eating and subsequent overweight predispose to diabetes and also blood vessel change consequently nutritional education needs wide spread publicity. Considerable attention has been brought to the relationship of infections of the gall bladder and the production of diabetes. Mayo Robson (37) some years ago mentioned this relation and said that diabetes might be averted by the early removal of diseased gall bladder. Today the view is held that such a procedure is a good diabetic prophylactic measure (23). Other focal infectious processes probably have a similar bearing and if possible elimination of the offending part is advisable. Focal infection is recognized as a probable etiological factor and a known factor in exaggerating an already present diabetic condition. The removal of a focus of infection is by no means a panacea for the prevention of diabetes but the relation of the infection to the diabetes at times is so striking as to be worthy of comment and observation.

Gangrene is a cloud which hovers over the diabetic of today. Its prevention will assure comfort and increased longevity to the diabetic. Strenuous measures should be instituted to this end. An undoubted but little understood relation exists between arteriosclerosis and gangrene occurring in the diabetic. Roentgenologically (8) it appears that the most favorable field for gangrene is in the arteriosclerotic diabetic and especially is this true when arteriosclerosis is combined with

hypertension. Of primary importance is the control of the diabetic situation as when under control the diabetic rarely suffers the disastrous effect of gangrene. Many prophylactic measures have been enumerated chief of which is cleanliness of the feet. It seems somewhat ludicrous to advise the use of soap and water, but when I recall the appearance of the feet of one patient who asked me to examine a sore on the toe I can appreciate Joslin's statement that he should be proud to have it recorded on his tomb. He taught Jew and Gentile alike to wash their feet." The promiscuous cutting of corns and calluses is dangerous as is witnessed often by the history immediately preceding the onset of gangrene. Foot and extremity exercise the use of the Buerger board physiotherapy (3) and the application of rules as suggested by Bernheim (6) tend to stimulate peripheral circulation and to aid in the prevention of abrasions and subsequent gangrene. Pain in the legs and cold extremities are premonitory signs and should be a signal for the institution of preventive measures.

SUMMARY AND CONCLUSIONS

The surgical death rate in the diabetic since insulin has been used has been reduced to one third. The question as to whether this decline is attributable to insulin is an academic one although the decrease is parallel to that of the general mortality rate of all diabetics since the application of insulin (15).

The united effort of surgeon and physician is essential to the management of the operative diabetic case and its successful outcome.

Careful pre operative preparation and post operative management tend to decrease the mortality.

The application of surgery is not now so much dreaded with knowledge of our present methods of prevention of acidosis and our assurance of combating it with its inception. With this renewed confidence operations are done at present on the more severe cases of diabetes and more extensive and severe operations are done on the milder ones. Needed surgical intervention in unrelated conditions (i.e. appendicitis, cholecystitis, tonsillitis) under precisely controlled condi-

tions should not raise the mortality percentage above that of the non diabetic. Notwithstanding these encouraging facts the diabetic patient still remains a greater surgical risk than his non diabetic brother.

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DIVERTICULA OF THE MALE URETHRA

A REPORT OF TEN CASES

ROBERT W. McKAY, M.D. AND J. A. COLSTON, M.D. BALTIMORE

A CAREFUL survey of the literature on diverticula of the urethra yields comparatively few reported cases and only a few of these reports give methods of treatment.

Watts (13) in 1906 was apparently the first in this country to go into the matter in any detail. He surveyed the literature up to that time finding 39 cases to which he added 1. It is interesting to note that this case is included in our series as BUI No. 586. In 1908 Ehrlich (4) brought the number up to 70. Roith (10) in 1908, Haberer (5) in 1911 and Englander (3) in 1917 added cases. Bumpus (1) in 1919 reported 4 cases in all of which the diverticula were located in the posterior urethra. Three occurred following perineal operations and one following the rupture of a tuberculous abscess of a seminal vesicle. No operative procedures were mentioned in the report. Johnston (7) in 1924 reviewed the subject stressing congenital diverticula that result from congenital cysts communicating with the urethra. He reported a huge cyst of the urethra (BUI 10930) arising apparently from the left duct of Cowper's gland. Rupture into the urethra of its pedicle would have produced a huge urethral diverticulum.

Howze (6) and Hennessey in 1923 reported a case of diverticulum of the posterior urethra containing a stone. Sisk (12) and Neugebauer (8) each reported cases in 1924. Peacock (9) reported a large diverticulum of the posterior urethra containing a stone and described his operative procedure. In 1926 Castro (2) reported a congenital case. In the same year Young and Shaw (15) reported a case from the Brady Urological Institute (Case 10 BUI 12332) following perineal prostatectomy. Young's perineal approach and repair of the defect was described in 1926 in the *Southern Medical Journal*. Schneider (11) in the same year published a similar procedure for posterior urethral diverticula.

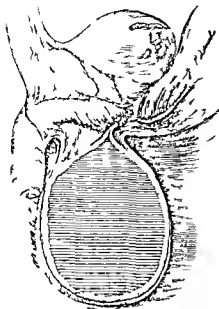
The increased frequency of recognition of the condition in recent years is undoubtedly due to a universal and intelligent use of the endoscope, the posterior urethroscope and the X-ray combined with radiographic media.

The classification advocated by Watts in 1906 is the one used by the majority of writers on the subject. It is as follows:

- A Congenital diverticula
- B Acquired diverticula
 - 1 From dilatation of the urethra due to
 - a Urethral calculus
 - b Urethral stricture
 - 2 With perforation of the urethra resulting from
 - a Injuries to the urethra
 - b Rupture of abscesses into the urethra
 - c Rupture of cysts into the urethra

To this classification we would add a heading namely *pseudodiverticula* of the urethra. We have included by this term urine filled urethral pouches communicating directly with the urethra that are a result of pathological dilatation of normal structures in the posterior urethra due to back pressure. Figure 2 shows a greatly dilated sinus pocus from a congenital valve obstruction. This pseudo diverticulum is due to expansion of the normal sinus pocus from back pressure.

In an earlier attempt at classification the diverticula were classed as true or false. True diverticula were those composed of all of the layers of the urethra from which they arose. False diverticula were those sacs the walls of which were fibrous tissue covered over by a lining epithelium that had grown into the pouch from the epithelium of the urethra. This classification was probably derived from the old concept of aneurism formation and it is no longer tenable because the results of frequent infection present in the sac may completely change the character of its wall.



DIAGNOSIS

The transitory subsiding tumor is occasionally seen but usually the diagnosis is made by means of the cysto urethroscope and X ray.

The urologist of today should recognize the importance of visual study of the urethra and should employ this diagnostic means routinely so that the condition will be recognized more frequently. A bismuth or lead catheter may be introduced into the cavity of the diverticulum and an X ray plate taken. The bladder may be filled with sodium iodide solution and the urethra obstructed by a band about the penis while the patient is instructed to void. In this way roentgenograms may be taken. Occasionally stone in the diverticulum renders the diagnosis easy either because of crepitus against a metal instrument or its appearance on the X ray plate.

SURGICAL TREATMENT

The surgical treatment varies with the size, position and anatomical relationship of the diverticulum to neighboring structures. Some of the surgical measures are illustrated by the following cases.

CASE 1. J. W. M. B. U. I. 856, a carpenter 36 years of age married was admitted to the Johns Hopkins Hospital May 6, 1903 with a complaint of difficulty in urination. The day before while at work he had fallen astride a beam of wood injuring the perineum so that there was complete retention of urine. Attempts at catheterization were unsuccessful until finally a silver catheter was passed. The patient developed stricture at the membranous urethra and sounds were passed. The catheter always found some residual urine varying from 100 to 40 cubic centimeters. Six months later he returned to the hospital complaining that there was great difficulty in urination and that when he began to strain in the act of voiding there appeared a distinct globular swelling in the perineum extending up toward the scrotum. As soon as urination had been completed this swelling would collapse. There had been no erections since the accident. He was catheterized with a silver catheter and about 1000 cubic centimeters of foul urine were drawn off. A retention catheter was then inserted. Examination revealed a fluctuating mass extending from the posterior part of the perineum forward along the urethra up to the scrotum and laterally to the ischiopubic ramus. The swelling involved only the perineal portion of the scrotum. If a catheter were passed into the bulbous urethra and pressure made on the tumor it was collapsed with the escape of purulent urine. A silver catheter passed into the bladder with

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As one would suppose the cases of acquired diverticulum are far in excess of those that are congenital and occur more frequently in the posterior than in the anterior urethra.

SYMPTOMATOLOGY

Urethral diverticula produce various symptoms depending on their location, size, depth and the degree of infection. Those located in the posterior urethra frequently present symptoms which are mistaken for posterior urethritis or verumontanitis. There is frequently present the picture of sexual neurasthenia found so often in inflammations about the verumontanum. Deep seated pain in the perineum, dysuria and dribbling at the end of urination are usually the most prominent symptoms. Sometimes the patient is able to empty the pocket by pressure on the perineum after the urinary act is completed. The proximity of the internal sphincter to the infected pocket may give symptoms resulting from a concomitant contracture of the vesical orifice. Diverticula of the anterior urethra present a fluctuating tumor that fills up during the act of urination and is easily emptied by pressure. The presence of stone however may alter its consistency and the ease of evacuation.

ase There was no stricture present. An endoscope introduced showed the prostatic urethra inflamed but otherwise normal. About 2 centimeters in front of the external sphincter there was a longitudinal opening on the floor of the bulbous urethra. Pressure on the perineum was followed by the escape of urine through this opening. A silver probe could be passed through the endoscope down into the orifice of the diverticulum. It was decided to excise the diverticulum.

Operation November 18 1903. Dr. Sowers. A metal sound was introduced into the urethra and a midline incision made down on the sound into the membranous urethra. The diverticulum lay anterior to the triangular ligament. The wall of the diverticulum was then dissected out and opened. It was continuous with the urethra and had formed finger-like projections anteriorly around the bulbous urethra. When these finger-like projections became distended they would tend to create pressure and collapse the anterior urethra thus producing obstruction. The sac was lined entirely with the mucous membrane of the urethra. The redundant sac was resected. A soft rubber catheter of good size was introduced through the anterior urethra into the bladder and the urethra sutured around it with interrupted catgut. The skin incision was then closed with black silk. The postoperative convalescence was uneventful. The catheter was removed from the urethra five days after operation. After its removal there was a small amount of urinary leakage through the wound. Sounds up to No. 30 F. were passed. Patient was discharged with the urethra closed and he was able to pass a good stream freely. He has been lost sight of since discharged from the hospital.

CASE 2 R. I. B. U. I. 3797 aged 26 single was admitted to the Brady Urological Institute January 6 1914 with complaint of chronic irritation in the neck of the bladder since childhood. As long as the patient could remember he had suffered from pain in the region of the neck of the bladder. It was dull aching in character and was relieved by voiding. There was marked frequency every half hour. The stream had been small weak in character and there was dribbling at the end of urination. He had had paroxysmal attacks of nocturnal emissions. Two months before admission there was an intensification of all symptoms and the time interval between attacks of severe pain became shorter. Patient had been very much upset mentally unable to sleep at night because of nervousness and frequency. Examination revealed the left kidney palpable the right kidney palpable a cyst of the right epididymus and slight prostatitis with adherent seminal vesicles. Patient was very difficult to cystoscope due to the fact that the head of the instrument was arrested at the region of the external sphincter. The posterior cysto-urethroscope revealed a distinct diverticulum in the bulb of the urethra. Its posterior limit was the external sphincter. By contracting the bulbocavernosus muscle the patient could empty the diverticulum under direct vision. With the cysto-

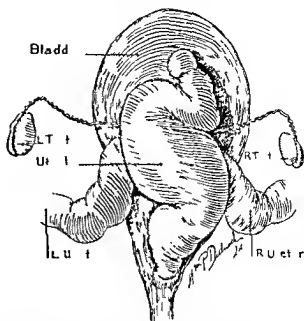
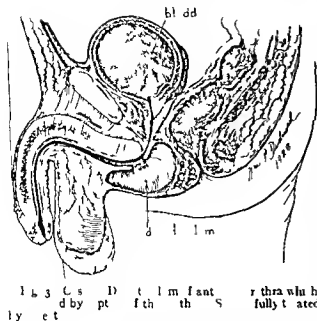


Fig. 2. Case of dilated utriculus forming pseudo-diverticulum of posterior urethra. Secondary to congenital valve. (Redrawn from Tolmatschew Arch. f. path. Anat. 1870.)

scope in the urethra the perineum was palpated with the index finger and as the finger was brought anteriorly a depression could be felt in the perineum at a point corresponding to the mouth of the diverticulum as seen through the posterior cysto-urethroscope. The urethra was filled with fluid and this caused the palpable depression in the perineum to disappear. It was possible to palpate the edges of the fibrous ring constituting the orifice of the diverticulum in the urethra. By means of the simple tubular endoscope the orifice of the diverticulum was easily seen with the external sphincter visible immediately behind it. The posterior urethra and fundus of the diverticulum were treated by applications of silver nitrate directly. This could easily be accomplished by means of the pouch pressed upward with a finger in the perineum. The patient was symptomatically very much improved as a result of this therapy. No operative procedure was carried out. Three months after discharge from the hospital he was still markedly improved. This improvement was probably due to the eradication of the infection in the posterior urethra and shallow diverticulum by the application of silver nitrate thereby diminishing the inflammatory reaction.

CASE 3 R. H. B. U. I. 5549 aged 24 years married was admitted to the Brady Urological Institute Johns Hopkins Hospital November 20 1916 with the complaint of knots on the side of the penis. He had had gonorrhea 7 years ago which lasted 3 months and had had a reinfection 1 year ago. He had had venereal warts. No marked urinary symptoms were noticed before the present illness. Five years previously he had had an inguinal bubo incised. Five months before admission there was some burning and difficulty on urination. He was treated with



sound and irrigations in another clinic. After one of the dilatations patient suffered severe pain and hæmaturia and he thought that the urethra had ruptured. After this the tumor of the pendulous urethra appeared. At the beginning of voiding the urine seemed to fill out a globular cavity in his pendulous urethra. After the act of urination was completed he was able to grasp the penis firmly and squeezed out at last a spoonful of urine. Examination revealed the penis of normal size with phimosis present. At a point midway between the penoscrotal junction and the meatus there was a distinct soft tumor on the ventral surface of the right side of the penis. The urine was grossly infected with bacilli. When the patient attempted to void a swelling appeared beneath the right side of the penis and was evidently caused by an accumulation of urine in a pouch communicating with the urethra. When the patient had emptied his bladder if the penis was grasped and the swelling squeezed as much as two teaspoonfuls of urine escaped. There was also present a general edematous cavernitis and periurethral infiltration. Filiform bougies and followers were passed. Apparently a rupture had been produced by the previous dilatation and behind the stricture there had occurred this definite diverticulum of the urethra. The patient was put to bed, hot compresses were applied to the penis, and attempts were made to dilate the urethra up to a point where examination of the diverticulum could be done under direct vision. The patient unfortunately after four days in the hospital refused further treatment.

This is a case of diverticulum due to traumatic rupture of the urethra produced by a wound passed to dilate a stricture.

CASE 4. G. V. H. B. U. I. 6374, aged 43 years, was admitted to the Brady Urological Institute

Johns Hopkins Hospital October 2, 1917, with a complaint of inability to void urine. Thirty years previous to his admission he had had a very severe attack of acute urethritis. A short time after this attack he developed acute retention and instruments were passed. Patient then had recurrent abscesses on the upper surface of the penis. These had been incised from time to time. Burning of urination had been present about 16 years. There had been some slight dribbling and a gradual diminution in the size of the stream. There was considerable dysuria when he entered the hospital. The general physical examination was negative. The external genitalia were normal. There was a slight watery discharge from the penis but no gonococci were found. Rectal examination revealed a prostatitis. The cystoscope was passed with difficulty; the instrument meeting obstruction in the bulbous urethra. The instrument however was finally passed and examination revealed a chronic cystitis with residual urine of 50 cubic centimeters. Due to the extent of fibrosis around the vesical neck a punch operation was advised. This was carried out after suprapubic cystostomy had been done. At operation by Dr. Geraghty, October 2, 1917, the vesical orifice was dilated and a diverticulum of the prostatic urethra was found. Its orifice opened just distal to the internal sphincter and ran forward beneath the mucous membrane of the prostatic urethra. It was easy to see that when the act of voiding began and the diverticulum was filled with urine its anterior roof was forced forward and upward and thus caused obstruction to the passing of urine. The floor of the prostatic urethra which constituted the anterior roof of the diverticulum was cut away thus converting the cavity of the diverticulum and the

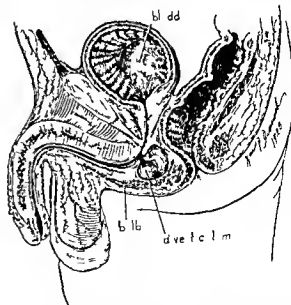


Fig. 4. Case D. t. l. m. occurring in bulbous urethra. Treated by puncture and infiltration with malleable instrument.

lumen of the prostatic urethra into one continuous cavity. The urethral floor was dissected away to within $\frac{1}{2}$ centimeter of the external sphincter. Care was taken not to damage the external sphincter as this constituted the only bar to incontinence. The cavity was then packed with iodoform gauze to control hemorrhage and the bladder was drained suprapubically. The suprapubic wound was closed. Convalescence was quite stormy for there was some infection of the wound and it was also necessary to operate upon the patient for gallstones. However the suprapubic wound was healed when the patient left the hospital he was voiding normally and the urinary tract was normal. He had lost some weight due to the gall bladder operation.

CASE 5 F H N B U I 7549 aged 49 years widower was admitted March 10 1919 to the Brady Urological Institute Johns Hopkins Hospital with a complaint of bladder trouble and weakness in the knees. He had been cystoscoped by two urologists who told him that he had a tabetic bladder. He had had two attacks of gonorrhoeal urethritis the first 30 years before and the second 20 years previous to admission. There had never been any symptoms referable to stricture. He had undergone a long course of treatment to the posterior urethra consisting of prostatic massage dilatation with a kohlman instillations of silver nitrate in the posterior urethra and silver nitrate applied to the verumontanum. This treatment was followed by temporary relief of the burning in the perineum. Each time however the symptoms of posterior urethritis would return. A sharp sensation of weakness and a peculiar burning sensation in the legs were also present. The patient was very introspective and was taking morphia. Wassermann reaction was repeatedly negative. The general physical examination was

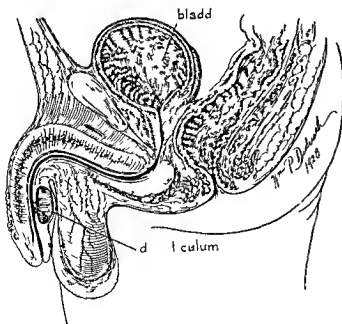


Fig 5 Case 3 Diverticulum of pendulous urethra caused by rupture of urethra from dilatation of a stricture. Patient refused treatment.

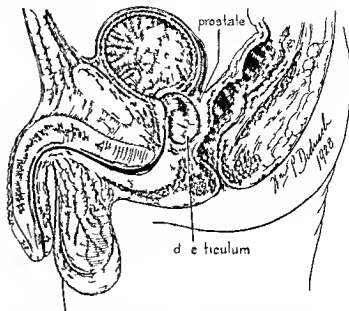


Fig 6 Case 4 Diverticulum of posterior urethra resulting from rupture of prostatic abscess illustrating obstruction to urination produced when diverticulum is full. Treated successfully by resection of roof of diverticulum and prostatic urethra into common cavity.

negative. The patient voided urine with a good stream and good control. The urine was not infected. Rectal examination revealed a prostatitis. Cystoscopic examination by Dr. Froetz revealed no residual urine but a slight degree of trabeculation on the anterolateral and posterior walls. The internal sphincter appeared to be slightly relaxed and the cystoscopic picture suggested rather a mechanical obstruction as opposed to a neurological bladder. With finger in rectum and cystoscope in urethra we could detect a definite thickening of the subtrigonal tissue. The cystourethroscope revealed a diverticulum in the posterior urethra which lay on the left side of the urethra posterior to the verumontanum. Lumbar puncture was done and examination of the spinal fluid was negative as was also the neurological examination. The patient presented the neurasthenia complex so often seen in patients with posterior urethral pathology. He remained in the hospital 3 days but refused any further treatment and was necessarily discharged.

This case illustrates very nicely the production of a neurasthenic reaction with posterior urethral symptoms caused by a diverticulum of the posterior urethra. The etiology of this diverticulum is not known.

CASE 6 A F M B U I 7836 aged 19 years white was admitted to Brady Urological Institute Johns Hopkins Hospital June 5 1919 with a complaint of incontinence. He gave a history of recurrent stones in the bladder treated by four cystotomies in another clinic. These operations occurred between the ages of four and seven. After the third operation there was dribbling of urine on slight

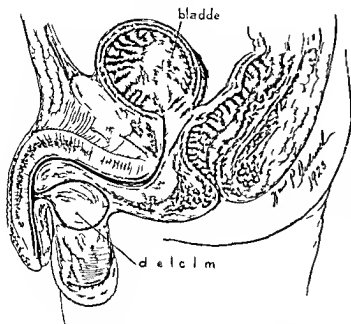


Fig. 9. Case 7. Diverticulum at peno-urethral junction caused by peri-urethral abscess. Formed large fluctuant tumor during voiding. Treated by resection successfully.

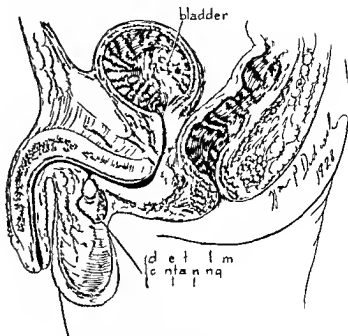


Fig. 10. Case 8. Diverticulum occurring at the peno-urethral junction and containing two calculi treated by resection.

CASE 7. J. M. B. U. I. 8420, aged 32 years, white, entered Brady Urological Institute, Johns Hopkins Hospital, December 4, 1919, with a complaint of inability to void urine. His past history was that he had had gonorrheal infections of the urethra for three years previous to admission. He has had acute retention three times during the past 4 years. There is great pain localized deep in the perineum. Patient places his finger in the perineum stating that pain lies deeply beneath it. Examination revealed no urethral discharge. A mass was felt on the ventral surface of the penis, beginning along the shaft about 2 centimeters anterior to the penoscrotal junction and extending backward into the scrotum where it was palpable as a soft, fluctuant mass occupying the base of the penis and spreading out anteriorly. I was sure upon this mass enabled one to empty it completely and a gush of cloudy urine was expressed from the meatus. The mass was described as being larger than a hen's egg. A large sound could be passed into the bladder without difficulty. When a catheter was passed into the anterior bulb and pressure was made the mass could be emptied through the catheter. Cystoscopy was done by Dr. Frantz. A posterior cysto-urethroscope was introduced into the bladder and disclosed marked inflammatory changes. The posterior urethra was also acutely inflamed. Anterior to the penoscrotal junction could be seen an opening of the diverticulum. Its orifice was irregular and jagged in outline measuring $\frac{3}{4}$ centimeter in diameter. A Greenberg cysto-urethroscope was then passed and the orifice of the diverticulum was plainly visible. One hundred and fifty cubic centimeters of 10 per cent thorium was allowed to flow into the bladder through a catheter after which the patient was made to stand up and

void. During the process of voiding the end of the penis was squeezed and the diverticulum promptly filled with thorium. An X-ray picture was then taken.

Operation was done by Dr. Frantz on January 5, 1920. The diverticulum of the urethra was excised. Patient was placed in the lithotomy position and the diverticulum was filled by being injected with sterile water through the penile urethra. An incision $2\frac{1}{2}$ inches in length was carried down the line of the median raphe to the diverticulum but neither tunica vaginalis was opened. The diverticulum was then freed, evacuated of its contents and dissected up to the orifice into the urethra which measured $\frac{3}{4}$ of a centimeter. The sac was then resected at its opening in the urethra and the urethra repaired. A No. 18 soft rubber catheter was introduced through the penis and passed on into the bladder and the edges of the urethra were then brought into apposition over the catheter by interrupted sutures of No. 28 catgut. The scrotal wound was approximated by interrupted sutures of plain catgut and the operative area was drained. Patient's stay in the hospital was complicated by influenza. A catheter was allowed to remain 10 days and the wound healed except for a fistula in the penile urethra. This was excised and the tissues brought together and overlapped over a No. 18 soft rubber catheter. After the withdrawal of this second catheter the patient was able to void his urine normally through the meatus of the penis.

Following discharge from the hospital he reported back to the Johns Hopkins Hospital at intervals over a number of months for dilatation of the urethra and the passing of sounds followed by irrigations and then was lost sight of.

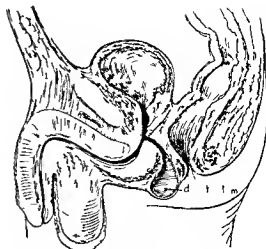
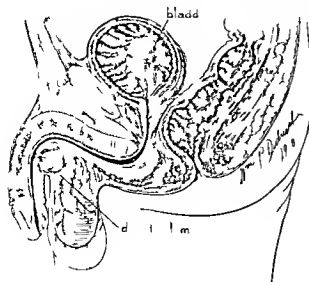


Fig. C. Section of diverticulum of penile urethra after prostatectomy. Labeled in Figures 13 and 14.

History of patient fully by C. O. D. T. L. M. of ant. o. u. e. t. h. f. u. e. t. h. a. w. t. h. s. t. r. a. i. g. h. t. p. e. t. n.

CASE 8. L. H. B. U. I. 14334 aged 49 years entered the Brady Urological Institute Hospital December 17 1925 with chief complaint of frequency and difficulty in urination. His general health had always been good. Fifteen months previous to admission he had had gonorrhea. His present illness began 3 years ago when he noticed difficulty in voiding. He went to his doctor who told him he had ruptured the urethra. This was followed by a small urinary fistula in the perineum. After treatment patient had increased difficulty in voiding and the fistula in the perineum persisted. He now experiences great difficulty throughout micturition and a dribble of pus occurs frequently at the end of urination. Examination reveals that the patient has had a syphilitic involvement of his vocal cords. Catheterization is encountered in passing a fluorin bag and follows along the urethra through the stricture. Marked periurethral induration is present around the site of the fistula. He was given no injections of neosphenamine preparation.

Operation as performed December 18 1925 by Dr. Scott. The diverticulum was not recognized before operation. The operation was undertaken with the idea of rectifying a stricture of the urethra and excising the urinary fistula in the perineum. The patient was placed in perineal position and a firm bulb was passed through the largest of the perineal fistulae. The fistulous tract was dissected free and it was then found that it connected with a second small fistulous tract and this in turn entered the bulbous urethra 1 centimeter in front of the triangular ligament. Here the operator encountered a round hard semi-fluctuant mass which proved later to be a diverticulum of the bulbous urethra. The diverticu-

lum was 2 centimeters in its greatest diameter and contained two well formed calculi. The sac with the stones included was excised. Following this the strictured area in the urethra was resected with the exception of a narrow strip of mucous membrane representing the anterior wall of the urethra. A catheter was passed through the urethra and laid against this narrow strip of mucous membrane constituting what was left of the dorsum of the urethra. The tissues on either side were then brought up and closed over the catheter by a running continuous stitch of plain catgut. This closed the defect in the posterior wall of the urethra caused by resection of the stricture and also by excision of the diverticulum. A small pack was necessary to control bleeding from the bulb. The skin was loosely closed with silk. The postoperative convalescence was eventful. The pack was removed the second day after operation. Catheter was irrigated frequently and removed in 9 days postoperative. The patient then voided a full stream through the penis only a few drops of leaking through the perineum. The newly formed urethra was dilated and the small fistula promptly healed. He was discharged from the hospital and could then void a good stream through the meatus without any perineal leakage. There was no dysuria and the urine had cleared up under bladder instillations. Closure of the diverticulum in this case was effected by lapping the surrounding tissue over a soft rubber catheter placed through the urethra.

Following his discharge from the hospital the patient reported back to the Johns Hopkins Hospital Dispensary for dilatations of the urethra with sound. There was no perineal leakage. He was voiding a good stream. Patient left the city and has not been heard from subsequently. He did not return to have his syphilitic condition treated.

CASE 9. C. K. G. B. L. I. 16665 aged 65 was admitted October 11 1927 to the Brady Urological

Institute Johns Hopkins Hospital with the complaint of difficulty in urination. Family history and past history were negative. His present illness dates back to 52 years ago when the patient while masturbating placed a straight pin in his urethra. The pin slipped away and in manipulations during the efforts to recover it the pin stuck through his urethra and he was unable to remove it. The end of the pin however did not perforate through to the skin. After the remarkable time of 32 years had elapsed while riding a bicycle he felt pain in his posterior urethra and going to his family physician the pin was removed from the skin posterior to the urethra. It was thickly encrusted with lime salts according to the patient's statement. Following this removal of the pin he had continuous difficulty dysuria and dribbling at the end of urination. Several abscesses developed near the site where the pin was removed. He was treated elsewhere by the passing of urethral sounds but at time of admission to the hospital great difficulty was experienced in urination and evidently quite an amount of stricture of the urethra was present. At time of admission he was able to force out only a few drops of urine at a time and this was done with great difficulty. The physical examination save for the local urinary condition was essentially negative.

Operation was done October 20, 1927 by Dr. Colston and Dr. McKay. Gas oxygen anesthesia was used. An incision was made around the bulbous swelling on the ventral surface of the penis. Skin and subcutaneous tissues were dissected off of a fluctuating swelling which connected with the urethra. The swelling proved to be a diverticulum which was mobilized freed dissected down to the urethra and easily excised at its junction with the urethra. A purse string suture of No. 1 plain catgut was taken around the periphery of the defect in the urethra and as the purse string was pulled tight the stump of the diverticulum remaining was inverted into the urethra. Reinforcing mattress sutures of plain catgut were taken bringing the surrounding tissue over the line of closure in the urethra. Skin and subcutaneous tissues were closed with sutures of fine silk. The method of closure in this case is almost identical with that which is shown in Figures 13 and 14.

A histological section of this diverticulum showed it to be lined with epithelium placed upon a fibrous base of connective tissue. There was considerable infiltration of the fibrous tissue with leucocytes and a few mononuclear cells showing a long persisting site of infection.

Convalescence was uneventful with very little febrile reaction. The catheter was kept in the urethra 10 days and was then removed. Following the removal of the catheter there was some urinary leakage during voiding through the incision on the ventral surface of the urethra. He was given a course of treatment with sounds and urethral irrigations and as a result of this the urethral wound granulated nicely and has completely healed.

The patient was seen 6 months after operation. He was voiding a good stream and was entirely relieved of his symptoms.

This case demonstrates a diverticulum formed by perforation of the urethra with subsequent abscess formation and a stricture of the urethra forming anterior to the site of the diverticulum.

CASE 10. I S V B U I 12332. Aged 69 years was first admitted to Brady Urological Institute Johns Hopkins Hospital April 8, 1924 with symptoms and physical signs of prostatic hypertrophy. Examination by Dr. Charles Bidgood revealed a large benign prostatic hypertrophy. A perineal prostatectomy was performed by Dr. Bidgood April 11, 1924. Patient's convalescence from this operation was uneventful. The wound was completely healed 25 days postoperative. Patient discharged from the hospital as well with slight amount of incontinence. He returned to the hospital September 8, 1924 complaining of a tumor appearing in the perineum during the act of voiding. Soon after the patient had completed the act of voiding this tumor would disappear from the perineum. Examination of perineum by Dr. Young showed well healed prostatic scar. Upon straining a bulging mass appeared at the apex of the prostatectomy scar protruding for a distance of 2 centimeters above level of the skin. Rectal examination revealed damage to the triangular ligament. By means of the posterior cystourethroscope the orifice of the diverticulum could be seen between the margin of the external sphincter and the verumontanum. This orifice of the diverticulum corresponded to the point at which the membranous urethrotomy was done at the time of the previous perineal prostatectomy. A cystogram was taken and showed relaxation of the internal sphincter and a urethral diverticulum connecting with the posterior urethra.

Operation was done by Dr. Young September 11, 1924. Caudal anesthesia was used—25 cubic centimeters 2 per cent novocain and 10 minims of adrenalin were injected. The urethral diverticulum was excised and the urethra closed at the neck of the sac by purse string suture with mattress sutures to reinforce the area. The skin was partially sutured with drainage on the right side. The mode of approach and the operative manipulations are the same as shown in figures 13 and 14. A No. 18 catheter was used to drain the bladder at the same time a repair of the external sphincter was done.

The patient's postoperative convalescence was uneventful. The wound promptly healed and he was discharged in excellent condition voiding a good stream with some incontinence. The urine was uninfected.

In a follow up examination of the patient 3 years after operation we find a disappearance of the diverticulum, the perineal fistula completely healed but some slight incontinence of urine still present.

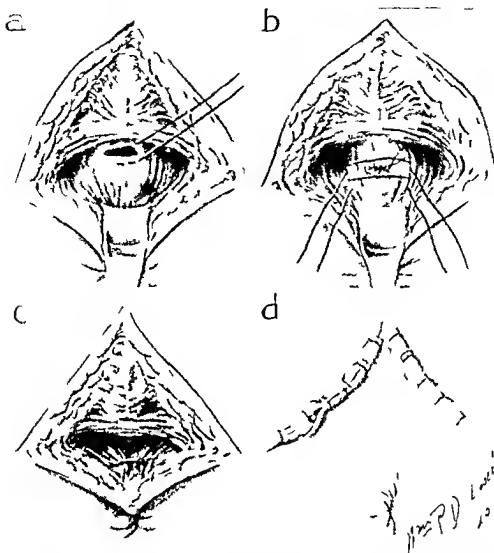


Fig. 14. a Purse string suture around orifice of diverticulum. b Purse string pulled tight. Adjacent tissue pulled over by mattress suture for reinforcement. c Stitches tied closing diverticulum. d Skin closure. (After Young and Shaw.)

tissues over by means of mattress sutures. The bladder is drained by an indwelling catheter through the urethra; the operative area is not drained, but skin and subcutaneous tissues are closed by fine silk or silver clips.

Type 2. Converting cavity of diverticulum and of prostatic urethra with one cavity. This type of operation is applicable only to those diverticula which are found in the posterior or prostatic urethra. It consists simply of a perineal or suprapubic approach with the idea of removing the roof from the diverticulum present and converting the cavity of the diverticulum and the cavity of the prostatic urethra into one common cavity. This insures proper drainage of the urethral diverticulum and also obviates the obstruction to

urination that the filling of such diverticula sometimes produces.

An analysis of the 10 cases reported shows that 7 were treated by operative procedures; 1 was treated by the injection of silver nitrate and 2 refused treatment. Only one was complicated by stone.

Of the 7 patients operated upon, 5 were treated by means of a complete resection of the sac followed by closure of the defect in the urethra over a soft rubber catheter. In 2 the roofs of the diverticula were dissected away, thus creating a common cavity between the urethra and the fundus of the diverticulum. One should note that the diverticula in these 2 cases were in the posterior urethra and in these locations such a procedure is feasible.

feature of the presence of the prostate. These diverticula were all shallow and the common cavity created by dissection drained well.

The case treated by applications of silver nitrate through an endoscope improved, the existing infection cleared up and because the entrance to the diverticulum was wide sufficient drainage was supplied.

Of the five patients treated by resection (Fig. 1 and 14) in 4 the diverticula occurred in the anterior urethra and in one in the posterior urethra just behind the external sphincter. The method used to close the defect in the urethra after the resection is complete is similar in all cases to the one illustrated (Fig. 1 and 14).

The mucous membrane of the diverticula turned into the lumen of the urethra by means of a purse string suture of plain catgut, a method similar to that used to invert the tunica of an appendix. A soft rubber catheter about No. 18 F. is placed in the urethra. A thick layer of surrounding tissue is then drawn over the point of closure for reinforcement and the subcutaneous tissues and skin are closed. The catheter should be kept in place *in situ* for 10 days or 2 weeks if tolerated well. In some cases subsequent dilatation is necessary.

SUMMARY AND CONCLUSIONS

1. Dilatation of the normal structure of the posterior urethra from distal urinary obstruction may produce pseudodiverticula.

Diverticula of the posterior urethra may simulate very closely posterior urethritis and varicocoele. Frequently the so called sexual neurasthenic syndrome is present.

In the case the filling of a diverticulum during micturition acts in a valvular manner to produce urinary obstruction.

4. Shallow diverticula of the posterior urethra are best treated by the removal of the tissues between the diverticulum and urethra to make one cavity.

5. Other diverticula are best treated by resection, repair of the defect in the urethra and the use of a retention catheter in the urethra to drain the bladder until healing takes place.

We wish to thank Dr. Hugh H. Young for the use of his facilities and Dr. Scott for the illustrations.

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THE DIAGNOSIS AND TREATMENT OF STERILITY DUE TO DISEASES OF THE FALLOPIAN TUBES

WITH A REVIEW OF THE LITERATURE AND BIBLIOGRAPHY

HENRY SCHMITZ M.D. F.A.C.S. CHICAGO

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OBSTRUCTION of the fallopian tubes is a frequent cause of sterility. If the character and mode of the causative infection are known and palpation reveals the presence of pathological changes, then tubal occlusion is readily diagnosed. If the causative factors are obscure and the local changes are not manifest on palpation, then the diagnosis is very difficult and surgical correction in many such cases will give unsatisfactory results.

The introduction of pneumoperitoneum, peruterine tubal inflation, and hysterosalpingography has markedly improved the means of diagnosis in gynecologic cases. Exploratory laparotomy is no longer justifiable or necessary to make a diagnosis of sterility due to tubal obstruction. Surgical intervention is indicated in the presence of clearly defined pathological changes in the tubes and such changes may be demonstrated by means of the new methods of diagnosis. Salpingostomy, resection of the isthmic portion and reimplantation of tubes into the uterine cornu and autogenous ovarian implantations into the uterine cavity after having been considered almost without value as so few pregnancies followed the surgical correction of tubal obstruction are again being considered as to their therapeutic value. More exact preoperative diagnosis and the use of peruterine tubal inflations may help to produce improved results in the surgical treatment of tubal occlusion.

In our clinical work a good deal of attention has been given to the newer diagnostic and therapeutic methods for the relief of sterility due to tubal obstruction. We have given special consideration to the literature of the entire subject to demonstrate the evolution of the new diagnostic and surgical measures. Pneumoperitoneum, tubal inflation, and hysterosalpingography and the surgical methods

of correction of tubal obstruction will be considered from the historical and clinical side.

PNEUMOPERITONEUM, TUBAL INFLATION AND HYSTERO-SALPINGOGRAPHY—HISTORICAL ASPECT

In 1902 Kelling inflated the abdominal cavity with filtered air and then inspected the organs through an ordinary cystoscope. This was probably the first attempt to add to the diagnostic methods of abdominal diseases the procedure of visual examination through pneumoperitoneum. Jacobaeus in 1910, Orndoff (73) in 1920 and Steiner in 1924 described similar procedures. Orndoff used not only direct vision but added X-ray observations to this procedure of endoscopy. The method has been termed celioscopy, laparoscopy, peritoneoscopy and abdominoscopy, respectively by these writers.

In 1913 Weber inflated the abdominal cavity with oxygen or air and subsequently made X-ray examinations. Rautenberg in 1914 and Goetze in 1918 made similar investigations. The latter discussed the applicability of the method to diseases of the pelvis in women, with the patient in the knee chest position. Stewart and Stein in 1919 placed the patient in the Trendelenburg position, produced pneumoperitoneum and then took X-ray pictures of the pelvic organs. They were able to depict the female pelvic organs in health and disease and to diagnose pelvic tumors, adnexal inflammatory tumefactions and so forth. Orndoff (72), LeWald, Peterson (75), Sante (93), Zwaluwenberg, Carelli and others published valuable contributions describing improvements in the technique and emphasizing the diagnostic importance of the procedure. Goetze, Peterson (75), Wintz and Stein and Arens deserve special credit for their exhaustive studies of pneumoperitoneum and roentgenography in pelvic diseases.

through them the method has become a valuable diagnostic procedure in gynecology and obstetric.

Cary in 1914 demonstrated the patency of the fallopian tube by the injection of a solution of collargol through the uterine cavity into the tube. The X ray picture taken immediately enabled the author to recognize patency of one and obstruction of the other tube. He was impressed with the new diagnostic method and it rendered unnecessary exploratory laparotomies in cases of suspected closure of the fallopian tubes without palpatory findings. Rubin immediately began to use the method. However it appears that the medical profession did not recognize the true value of salpingography. It is interesting to note that Stone in 1896 injected sublimate solution through the cervix into the uterine tube during laparotomies to demonstrate obstruction in the lumen. He later used tincture of iodine.

The method of salpingography had passed into oblivion when Rubin (87) in 1900 published his observations on "The Non-Operative Determination of Patency of the Fallopian Tube by Inflation of Oxygen Through the Cervix," reporting 55 cases without any untoward results. The technique was rapidly improved, indications and contra-indications were determined, the diagnostic value was enhanced by observing various signs such as pelvic pain, shoulder pain, pneumoperitoneum and so forth. The diagnostic procedure received wide recognition. Those interested are referred to references 1, 6, 10, 13, 18, 19, 23, 24, 30, 36, 65, 70, 76, 83, 84, 89 and 95.

Cary, however, the method of filling the uterine tubes with an opaque emulsion and taking X ray picture afterward was revived. The revival appeared to be attributable to two factors: (1) the results of tubal gas inflation did not always agree with the bioptic findings during operation; (2) the exact location of the tubal obstruction could not be determined. Curti had already advised the inflation of the tubes through the abdominal tubal ostium during laparotomy. It is evident that a diagnostic method which would enable one to locate the site of the obstruction be-

fore operation would improve prognosis and treatment. Kennedy (49) in 1923 reintroduced salpingography in order to determine before operation the location of the obstruction. He used a 0 per cent aqueous solution of sodium iodide to fill the uterine cavity and tubes and made immediate examinations with the X rays. Kennedy for instance found that in about 30 per cent of the cases the tubal obstruction was in the isthmus portion. For dyke (4), Fraenkel (26), Schober, William and Reynolds, Cotte and Bertraud (14), Newell, Randall and others have investigated the method and contributed to the high development of the technique. Salpingography has been combined with pneumoperitoneum by Stein and Arens and by Jung and Schirmer to improve diagnostic findings. The study of the anatomy of the intramural portion of the uterine tubes by salpingography was reported by Reinberg and Arnstam while isthmospasm and tubal peristalsis were investigated by Rubin (91) with gas inflation and the kymograph.

DIAGNOSTIC ASPECTS

Tubal inflation, salpingography and pneumoperitoneum are recognized procedures in gynecologic diagnosis and are indicated as follows: (1) Peruterine tubal air inflation is used to test in the absence of palpatory findings the patency or non patency of the tubes if potency of the male partner has been assured and the patient is desirous of offspring. (2) Salpingography is used to locate the site of obstruction. The operative methods to be used can thus be determined before operation. (3) During operation the patency or non patency of the uterine tube may be tested with peruterine gas inflation through the cervix and after operation the results of salpingostomy, tubal resection and implantation may be investigated by gas inflations repeated at 10 day intervals. (4) Pneumoperitoneum eventually combined with salpingography is employed to make a differential diagnosis in obscure pelvic and abdominal conditions as early pregnancy, ovarian cysts, myoma, polyps, inflammatory tumefactions, retroperitoneal tumor and so forth.

The method are contra-indicated (1) in the presence of amenorrhoea unless pregnancy can

be absolutely excluded (2) In the premenstrual phase as the endometrium is then thickened and may temporarily obstruct the uterine tubal ostium or endometrial shreds may be forced into the peritoneal cavity (3) In the presence of uterine hemorrhage for uterine contents such as endometrial or cancerous shreds may be forced through the tubes into the pelvic cavity or air may enter the blood stream through the open blood vessels Air has been proved to be dangerous and to cause air emboli while oxygen and carbon dioxide forced into the blood vessels are deemed harmless as they are rapidly absorbed by the blood corpuscles (4) In acute and subacute infections of the genital tract air inflation and lipiodol injections must not be used unless the infection has subsided as determined by the temperature the leucocytic and differential leucocytic count and the sedimentation test all of which should remain normal after repeated local examinations or manipulation especially near the menstrual period Profuse purulent leucorrhœa and extensive chronic cervicitis with profuse secretion also should be treated and cured before these diagnostic tests are undertaken (5) In serious organic diseases of the heart the kidneys the lungs metabolic disturbances adiposity, and the lymphatic state for the use of pneumoperitoneum necessitates the use of large amounts of gas The small amount (5 to 10 cubic centimeters) of gas or lipiodol used in inflation and salpingography are of course without danger

The results of tubal inflation may be designated as plus (+) if tubes are easily permeable to a pressure of 40 to 100 millimeters mercury as plus minus (\pm) that is doubtful if the air passes only slowly with a pressure of 100 to 150 millimeters mercury and as minus (-) if the tubes are closed to pressures of 150 to 200 millimeters mercury

The technique of peruterine tubal inflation and the introduction of lipiodol is very simple The instrument used is shown in Figure 1 It contains the modifications suggested by Furness Gladstone and Miles The instrument is self retaining and has a three way stopcock to manipulate constant pressure if desired We use air exclusively and have never observed any untoward result The patient is placed on

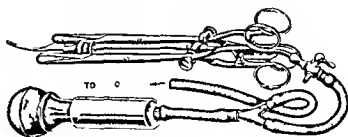


Fig. 1

a cystoscopic table provided with a Bucky diaphragm If the Rubin test proves doubtful or negative then a salpingography is added immediately to determine the site of the obstruction The Y shaped connection is removed from the cannula and a rubber bulb syringe containing 10 cubic centimeters of lipiodol is attached The oil emulsion is injected slowly As soon as the patient complains of pain the stopcock is closed and the X ray picture taken After an interval of 5 to 10 minutes another X ray exposure is made The same procedure is employed after operations to test the result of operative corrections of tubal obstructions Pneumoperitoneum is only rarely necessary in the diagnosis of sterility due to closed tubes without palpable changes and has been omitted from description Other conditions that may be determined with the newer diagnostic methods also have not been considered If tubal inflation is positive then salpingography is unnecessary

It is of importance to note that tubal inflation and salpingography should be repeated at an interval of a week or a month if negative results are obtained At a subsequent examination patency of the tubes may be found One also should remember that such examinations should be made in the postmenstrual period In the premenstrual period the hypertrophic endometrium might obstruct the uterine tubal ostium The diameter of the normal lumen of the intramural portion of the tube measures from 0.8 to 1 millimeter according to Zorn The second X ray picture taken 5 to 10 minutes after the oil injection will often show the diagnostic spill of the oil emulsion while the first X ray picture may exhibit the oil confined in the tubes It also appears that the oil surrounds the ampullary portion of the tube just as the blood accumulates around the



Fig 2. Normal tubes

ampulla in tubal abortion. The presence of oil in the free pelvic cavity probably represents a violent contraction or peristalsis or aspiration of the uterine tubes.

The results of salpingography are depicted in Figures 2 to 7. The legends describe their diagnostic imports.

SURGICAL TREATMENT

The surgical methods for the relief of tubal obstruction may be divided into (1) salpingostomy (2) tubal resection and reimplantation into the uterine cornu and (3) autogenous ovarian transposition.

Salpingostomy. Salpingostomy consists in freeing the tube from adhesions and making a new abdominal tubal ostium. A Martin recommended the operation in 1889. In 1895 he reported 65 operations with two pregnancies in 47 cases that were followed up. Gouilhoud considers the desire for offspring an indication for salpingostomy if the sterility is due to closed tubes. Gellhorn states that the operation is justifiable in tubal occlusion from tubal pregnancy, chronic appendicitis, hydrosalpinx and hematosalpinx. The mucosa of the uterine tubes should be normal. Hence gonorrheal and tuberculous salpingitides contraindicate operation. Perisalpingitides give a better end result than endosalpingitides. Dudley (6), Kehrer, Posenstein, Gellhorn, Loehnberg, Bullard, Child, Seitz, Jolles, Nuernberger, Strassmann, Bjorkenheim, Hirst, Mazer, Ritter, Unterberger, Heilmann, Is-

bruch and Curtis among others have reported pregnancies after salpingostomy.

The percentage of relief from sterility may be obtained from a study of the number of patients who became pregnant after salpingostomies (Table I).

The percentage of cures is therefore 83.6. Evidently a great number of tubes closed again after the operation or the obstruction in the intramural portion was not recognized during operation or a badly diseased tube was not removed. Reynolds expressed the opinion that if one tube presents a mild salpingitis that is a closed tube without much chance while the other tube remains normal the woman is invariably sterile. To insure continuation of patency after salpingostomy, Sellheim (99) uses a twig of heavy catgut placed in the tube and tied to the abdominal ostium. Fraenkel (27) and Rosenstein deny the advisability of performing salpingostomy if tubal pregnancy has previously occurred unless the patient has been advised of the danger of a recurrence of tubal pregnancy. Kubin and others advise repeated tubal infusions at ten day intervals following the operation to prevent adhesions and closure of the abdominal ostium.

The statistics were obtained from cases operated on before improved methods of diagnosis were introduced in gynecology. Whether the newer methods of preoperative diagnosis of the site of obstruction or the postoperative control of the plastic operations on the tube will improve the results must be determined by future reports.

TABLE I.—PREGNANCY AFTER SALPINGOSTOMY

Ath	Th	Ca	Ca
Alm	4	2	
M. k. rod	3	2	
Thal	9	2	
Loehnberg	4	0	
Bullard	44	3	
Gellhorn	4	2	
Seitz	5	2	
Prohmann			
Ritter	64	4	
Strassmann	0		
Unterberger	57	5	
Isbruch	14	4	
Fraenkel	1	1	
Total	37	3	



Fig 3 Closure at interstitial portion of left tube. Closure of the abdominal ostium of right tube. Taken October 31 1927



Fig 4 Same patient as shown in Figure 3 after implantation of left tube and opening of abdominal ostium of right tube. Taken December 28 1927

Resection of the isthmus portion of the uterine tube Tubal resection and reimplantation in the uterine cornu are indicated when the salpingogram shows occlusion in the intramural and isthmus portions of the uterine tube. If closure of the abdominal ostium exists then salpingostomy should also be done. Strassmann (110) should be given credit for the fact that he decided on the operation after salpingography though Watkins in 1899 had performed the operation and the patient became pregnant afterward. Shaw reported a similar operation in 1921 and the first full term pregnancy after such an operation in 1922. Since then Nowak, Unterberger and Strassmann also reported full term pregnancies. To safeguard maintenance of the lumen after the operation, Kennedy inserts a caryole membrane hardened in alcohol for 48 hours from one abdominal ostium through the tubes and uterine cavity and out through the opposite tube. The membrane is 40 centimeters long and 3 centimeters wide. Sellheim uses a special trephine. The instrument is not necessary in the operation as a sharp scalpel will do as well. Tubal resection and implantation into the uterine horn may also be indicated after removal of a cornual myoma after pregnancy in the intramural and isthmus part of the uterine tube and after tubal sterilization for therapeutic indications to re-establish the tubal lumen.

Ovarian transposition The transposition of half an ovary left in contact with the normal blood and nerve supply to the corresponding uterine horn according to Estes or the implantation of the whole ovary left connected to the normal nerve supply into the uterine cavity as advised by Dudley, Tuffier, Bell, Sellheim and others and ovarian grafting as performed by Morris are indicated for the relief of sterility due to the absence of both uterine tubes.

The transplantation of autogenous homogeneous and heterogenous ovarian tissue has interested the medical profession for many years. Animal experimentation carried on by Knauer, Grigorieff, Schultz, Ribbert, Herltzka, Foa, McCone, Halban, Dick and Curtis, Dederer, Kross among others with autogenous homogeneous and heterogenous ovarian tissue have demonstrated that autogenous grafting and transposition are the best methods of maintaining menstruation and assuring future pregnancies.

Franklin H. Martin (58) has investigated the clinical value and elaborated on the operative technique of ovarian transplantation and has published a most exhaustive literary review of the subject. He states that it is a justifiable operation to conserve menstruation and



Fig 5. Same patient as in Fig 3 but taken from a different angle. The operation was performed with the patient in the dorsal position.

to promote future pregnancies although but few pregnancies have been recorded. Instead of transplanting ovarian tissue into the abdominal wall to preserve menstruation Tuflier transposed the whole or part of the ovary still in contact with the normal blood supply into the uterine cavity to assure future conception. Chalfant Pinkow and Bell agree with these investigators. References 3, 21.

5, 39, 55, 66, 77 and 101 contain observations pertaining to the various phases of ovarian transplantation.

Pregnancies after ovarian grafting have been reported by Polk, Morris (66), Frank, Dudley, Storer, Bainbridge, Sippel, Estes, Gellert and others. Estes states that the preservation of ovarian tissue and the placement of the latter that ripe ovum may find entrance into the uterine cavity is the duty of every surgeon who must operate on the internal generative organs of a young woman. Condition possible for fertilization and pregnancy may be brought about if functioning ovarian stroma be implanted upon the mucous lining of the uterus directly over the inner opening of one or both uterine tubes in the horn of the uterus. Within 20 years he saw five pregnancies in 45 follow-up cases or 11.11

per cent. The results compare favorably with those obtained with salpingo-tomy. It is of interest to note that Sippel transplanted active ovarian tissue from one woman to another having inactive ovaries and obtained three subsequent pregnancies.

DISCUSSION

The treatment of sterility caused by closure or absence of the fallopian tubes deserves our earnest attention. The desire of a sterile wife mated to a potent husband to bear off progeny and to submit to any measure to attain that end should be heeded. The newer method of gynecologic diagnosis, namely, pneumoperitoneum, peruterine tubal inflation and hysterosalpingography, have created renewed interest in the surgical treatment which is now carried out on a more scientific basis. Patients whose fallopian tubes have been closed by peritubal inflammations—such as appendicitis and parametritis—patients with extra-uterine pregnancy with myoma and those who have had sterilization operations performed will probably react better to surgical corrections than will those who are suffering from endosalpingitis due to gonorrheal tuberculous and ectopic infection. In the former group the mucous membrane of the tubes may remain intact while in the latter group the mucosa may be damaged to a great extent. We have frequently observed that the freedom of adhesions in the patient with perisalpingitis also opens the almost intact imbricated extremity of the oviduct. The many reports in the literature on the surgical treatment of tubal closure for sterility which have been made since the introduction of the newer method of diagnosis give evidence of the great interest in the question. The treatment of female sterility has not been satisfactory. If the 15 per cent of cases of sterility caused by tubal obstruction are followed by a greater number of conceptions after surgical resection than prevailed before the new era, then the efforts described have been well spent. A careful follow-up of the cases is the only means to settle the value or uselessness of the plastic operations devised. During the last year, 13 salpingostomies and 3 tubal resections with induction into the uterine horn were done in



Fig. 6 Same patient as in Figure 3 taken one day later than Figure 5. The iodine oil is now freely distributed throughout the pelvis.



Fig. 7 Same patient as shown in Figure 6 but taken 6 days later. It shows the iodine still present in the pelvic cavity.

our clinic. The operative procedures were predetermined from the hysterosalpingograms. Controls after operation with tubal inflations were positive in only 4 cases. Pregnancies have so far not been reported.

SUMMARY AND CONCLUSIONS

1. The historical and clinical aspects of pneumoperitoneum, peruterine tubal inflation and hystero-graphy have been given, and the technique described. These procedures enable the surgeon to make a correct diagnosis of the obstruction and to determine the site of the lesion.

2. The historical development of plastic operations on the tubes and ovaries for the relief of sterility has been discussed and the technique of the operations given.

3. If a patient whose husband has been proved potent desires to bear offspring, operation is indicated to restore the lumen of obstructed tubes or in the absence of the tubes to transpose the ovary into the uterine cavity or cornu.

4. The patency of the reconstructed uterine tubes may be maintained by the insertion of twigs of catgut or caryle membrane into the tubes and by air inflations repeated every

10 days and eventually controlled by hystero-graphy following the operation.

5. The possibility of conception after such operations has been shown by many reports from the medical literature.

6. The writer expresses the opinion that the newer methods of gynecologic diagnosis have created renewed interest in the surgical correction of tubal obstruction and established a more scientific basis for such procedures. Careful selection and follow up of cases are the only means which will enable us to judge whether or not such treatment is justifiable.

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Fig. 1. Same patient as shown in figure 3, but taken months later, showing the results of the operation. The patient is now well and is able to carry a pregnancy.

to promote future pregnancies although but few pregnancies have been recorded. Instead of transplanting ovarian tissue into the abdominal wall to preserve menstruation, the better transposed the whole or part of the ovary still in contact with the normal blood supply into the uterine cavity to assure future conception. Chaffin Pankow and Bell agree with the investigators. References 3, 21, 50, 55, 66, 77 and 101 contain observations pertaining to the various phases of ovarian transplantation.

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THE HYDROGEN-ION CONCENTRATION OF THE ENDOCERVICAL SECRETIONS¹

WITH SPECIAL REFERENCE TO CHEMICAL FACTORS IN THE CAUSATION OF STERILITY

SAMUEL R. WEAKER, MD, FACS, BOSTON
Assoc. Prof. of Gynecology, Boston School of Med.

AND

WILLIAM GLASER, MD, BOSTON
Asst. Prof. of Gynecology, Boston School of Med.

MORE than 60 years ago Marion Sims (9) wrote: "The vagina and the canal of the cervix each secrete a mucus peculiar to itself. That of the vagina is acid, that of the cervix very slightly alkaline." He went on to note that under abnormal conditions the secretions in either region might become lethal to spermatozoa, one of the most troublesome obstacles of this sort being an excessive acidity in the vagina.

These views were generally accepted and vaginal over acidity soon came to be regarded as an important factor in the causation of sterility. Jackson (5) writing in 1887 said:

"The most frequent cause of the untimely death of spermatozoa is the acid mucus of the vagina. The degree of acidity varies greatly in different women and in the same woman at different times. Not infrequently a decidedly sour odor may be detected during the introduction of the speculum, and the mucus at such times will intensely redden litmus paper. Spermatozoa perish immediately in such a fluid. This condition is thought by some to be more frequent in blonde women with red complexions than in brunettes. On the contrary, the slightly alkaline mucus of the interior of the uterus is favorable to the vitality of the spermatozoa, as already shown. But when the uterine secretions are altered by disease they likewise cause their speedy death."

MODERN VIEWS ON THE VAGINAL CHEMISTRY

In any consideration of the features of the vagina it should be clearly understood that two commonly used terms, *mucous membrane* and *secretion* are in the strictest sense misnomers. The vagina contains no glands and produces no mucus; its lining represents his-

tologically a transitional stage between true mucous membrane and skin. The vaginal content of moisture is a composite of four items: mucous secretion from the cervix, desquamated epithelial cells and the products of their disintegration, bacteria and the products of their activity, and a certain amount of intrinsic vaginal fluid, which is not a secretion but a transudation of extravascular lymph through the epithelial layers.

In recent years the chemical reaction of this vaginal content has received considerable attention. The range of its normal acidity according to Kraus and Bodnar (8) is from pH 2.8 to pH 5.0. The same observers note an increased acidity toward the end of pregnancy, the values ranging from pH 2.7 to pH 3.0. Kessler and Uhr (7) give pH 4.0 as the average vaginal acidity in pregnancy. The range in infants, as observed by Kessler and Roehrs (6) is from pH 4.0 to pH 6.0.

Variations in the vaginal reaction have been studied not only in their bearing on sterility but also in their relations to physiological ovarian activity and to pathological infection.

In relation to the ovarian cycle Graefenberg (3) discovered that the amount of lactic acid in the vagina is increased just before, during and just after menstruation. He draws the conclusion that the vaginal chemistry is to a certain extent controlled by the ovaries, somewhat as the vaginal histology is influenced in the oestrus cycle of animals.

This conclusion appears to us untenable. One important source of the vaginal acid mucus contributed by the cervix and acidified in the vagina by the action of Doederlein's bacillus. We know that this mucus, while it is still within the cervix, shows no cyclic variation in its chemistry, and we cannot imagine

any way in which ovarian activity could influence the vaginal bacteria. In all probability the increased acidity observed by Graefenberg is due simply to a larger physiological production of cervical mucus a raw material out of which vaginal acid is manufactured.

In relation to infection. Numerous observations have been made upon leucorrhoeal discharges in which there is of course an indistinguishable mingling of cervical and vaginal elements. The general tendency in infection is toward alkalinity. Kraul and Bodnar (8) found that the foul and purulent leucorrhoea has an alkalinity of pH 8.0 while in the milder types of infection the values range from pH 6.2 to pH 7.3. Danin () suggests that an alkaline vaginal reaction may be an important finding in the diagnosis of gonorrhoea.

In relation to sterility. It was formerly believed that the semen was deposited at ejaculation in the posterior vaginal vault or receptaculum seminis and that a certain number of spermatozoa found their way subsequently into the cervix. In other words all of the spermatozoa were thought to remain for a time in the vaginal environment. If such were the case the favorable or unfavorable character of that environment would naturally be a matter of the highest importance and it was so regarded until 15 years ago.

In 1913 Huehner (4) published his valuable experiments in postcoital examination. From these he concluded that even the normal vagina is hostile enough to damage spermatozoa almost immediately and that the only spermatozoa which have any reasonable chance of reaching the ovum are those deposited at ejaculation either directly within the cervical canal or at least upon the os externum. If this conclusion were strictly correct then the character of the vaginal environment would be a matter of no importance whatever so far as fertility and sterility are concerned.

We are not in complete accord with either view. Without a doubt the normal vagina does damage spermatozoa; one commonly finds all of those in the vagina dead within an hour or two after intercourse while in the cervix they may live for days. Without a doubt also the ideal anatomical relations are

such as permit direct cervical insemination whereby some spermatozoa avoid the vaginal environment altogether when other anatomical relations exist sterility is the usual result. Nevertheless we feel that the vaginal chemistry may play a part in the process of insemination in special cases when it is either less hostile or more hostile than the ordinary.

If the vaginal moisture is scant and only weakly acid it will of course not damage spermatozoa with the same promptness or to the same degree as moisture of the usual character. Moreover the vaginal acidity can be temporarily counteracted by the deposition of a large volume of semen which is alkaline or by a copious outpouring of the even more alkaline cervical mucus. A fortuitous combination of circumstances like these may so reduce the hostility of the vaginal environment that spermatozoa are able to live therein for a considerable time and ultimately to reach the cervix in spite of unfavorable anatomical conditions. Thus are explained the cases in which pregnancy has resulted from vulvar ejaculation without penetration.

On the other hand if the vagina contains a large amount of intensely acid moisture all of the semen is likely to be contaminated at the moment of ejaculation. Even in the presence of normal anatomical conditions the cervix will then receive only damaged spermatozoa. In cases of this type the antecostal alkaline douche has occasionally proved to be an effective treatment for sterility.

MODERN VIEWS ON THE CERVICAL CHEMISTRY

From the time of Sims it has been recognized that the endocervical mucus normally favorable to spermatozoa may under pathological conditions become so altered as to be intensely hostile. Four types of hostility have been described: mechanical, bacteriological, serological and chemical. The prevalent theory with regard to chemical hostility assumes that the cervical secretions may be acid in some cases and excessively alkaline in others.

For years we have carried out in sterility cases a routine litmus test on the endocervical mucus. No excessive alkalinity has been observed. In occasional cases however we have encountered an acid reaction. We now believe

that in all such cases our test was technically faulty, the acid reaction being not that of the cervical secretions proper but that of vaginal moisture which either lay just within the os externum or was carried in by the litmus paper.

Three years ago a careful study of the cervical chemistry in 100 cases was made by Kraul and Bodnar (8) who stated that the normal reaction of the endocervical mucus ranges from pH 6.6 to pH 6.8 in other words that it is faintly acid. They obtained alkaline readings up to pH 7.5 only in cases of endocervicitis. Such results entirely at variance with ours reported in this paper are difficult to understand except on the assumption that Kraul and Bodnar collected the cervical secretions by a method which allowed considerable vaginal contamination. In certain particulars their results agree with ours; they found that the reaction shows no cyclic variation and that it is not influenced by the amount or the consistency of the endocervical mucus.

ORIGINAL INVESTIGATIONS ON CERVICAL CHEMISTRY

A year ago we shared in the common belief that the endocervical mucus might vary considerably in reaction and might at times be hostile to spermatozoa by reason of chemical abnormality. With a primary view to ascertaining first the extent of variation and second the limits within which spermatozoa could survive we undertook to carry out an accurate determination of the hydrogen ion concentration of the cervical secretions. We have made 100 observations on 95 different patients and herewith report the results obtained.

Technique of obtaining secretion. The cervix is exposed with a bivalve speculum in the usual manner. Its vaginal surface is carefully wiped dry with cotton. With another small bit of cotton the lower part of the endocervical canal is wiped as dry as possible.

A glass cup as large as will pass through the speculum is fitted snugly over the tip of the cervix. Within the cup a partial vacuum is produced by means of a rubber bulb. Suction is maintained in this way for 5 minutes.

When the cup is taken off several drops of mucus can usually be obtained. If an inspissated plug occupies the endocervical canal its removal will be followed by a clear flow. The mucus is best picked up with a glass syringe which has a nozzle with a bore of about 3 millimeters.

Technique of chemical test. We use a colorimetric method in the determination of hydrogen ion concentration. The standards are buffer solutions designed by Clark and Lubs (1) checked by means of hydrogen electrode. The indicators are phenol red (for values ranging from pH 6.8 to pH 8.0) and thymol blue (for values ranging from pH 8.2 to pH 9.0).

Since only a small amount of the material to be tested is available we employ the spot method. A drop of cervical secretion is placed in one depression of a glazed white porcelain plate; in other depressions are placed drops of several standard solutions. A drop of indicator is added to the secretion and to each of the standard solutions and thoroughly mixed by stirring with a fine glass rod. The reading is then obtained by direct comparison.

Results. Table I shows *in extenso* the results of our observations. In each of the 100 cases we have recorded not only the pH value of the cervical secretions but also data on certain factors which according to our expectations at the beginning of this study might be found to have an influence on the cervical chemistry.

The lowest value encountered in the entire series of observations was pH 8.0. The highest identified was pH 9.0 in one or two cases there was a suggestion that the alkalinity of the secretions might be even higher, but this was not verified because we were not equipped with buffer solutions of higher alkalinity. In 84 per cent of our 100 cases the values were within the upper half of the range, that is above pH 8.5.

From the data at hand we are able to formulate more or less definite conclusions about the possible influence on the cervical chemistry exerted by the following factors: age, parity, hypoplasia, the menstrual cycle, endocervicitis and viscosity of the endocervical mucus.

TABLE I—SHOWING IN ONE HUNDRED CASES THE HYDROGEN ION CONCENTRATION OF THE ENDOCRINAL SECRETIONS TOGETHER WITH CERTAIN POSSIBLY RELEVANT CLINICAL DATA

Ca	II	A	P y	Hypopl	D y f yl	E d tis	V sc y	pl
				++		+		
				++			+++	8
		3			5	+++		3
		8			5	+	++	3
		8		++	7		+	3
					7		+	8
				+++		+	+++	8
				+			+++	8
							+++	8
		5		+	5			8.8
				++			+++	3
				+	0		++	8
		5				+	+++	8
		9						
6	111					+	+++	8.8
7	11					+	+++	8
8	11	3			?	+++	+++	8.3
	(P) 8	4	3		1 m p 1			8.3
	11	7			N			8
	11	8			8		+++	8
	11	6				+	+++	8
	11				?	+++		8
	11				?			8.8
	11	3			7			8
	11						+++	8.7
	11	7	7		4			8.1
	11 8	35	8					8.8
	11				7			
	11				?			
	(11) 06							
	11	30						
	11				7			
	11 8	8			8			8.8
	011 8.7				7			9
	(11)				7	+++		
	111 7			++		+++	+++	8
3	011 8					++		
	(11)							
	(11)							
	(11)		5		6			8.8
	11							
	111 8							8.8
	11							
	011	3				+		
7	11							
	011 5				Am hce			8
	111 5	3	9		1 m p 1			8.8
5	111 10					+		
	11	8			7	+		8
	11					+		8
5	11 on							8.7
54	011 D 3	7			Am hce			8
	11				7	+	+++	
5	11	7				+	+++	
	11							
	(11)							8.8
	011	5			Am or hce		++	9

TABLE I—Continued

Ca	Id tifi t	Ag	P ty	Hypopl	D y l	E d t	V ty	pH
6	O I D 84505	16						8.0
6	O P D 0988	0			4			8.7
01	O I D 09400	11			4			8.8
64	O I D 848 5	43	3		1 t p l			8.8
65	O I D 86054				1			8.7
66	O I D 84 1				1	+++	+++	8.8
67	O I D 84 4				6			8.8
68	O I D 78008	41	5		5	+++	+++	8.8
69	O I D 51 7	0			2		+++	0
7	O I D 8 4	9			1 g t m		++	8.8
7	O I D 86045		3		1		+++	0
7	O P D 8608	43			4			8.8
73	O I D 87 8	1	1		4		+++	0
74	O I D 847	5	2		3	+		8.7
75	O I D 87 7	8			1 g t r	+++		8.8
76	O I D 87 7				1	+++		0
77	O I D 871 0	1	1		5			8.8
78	O I D 3	63	8		1 t p l			8.8
79	O I D 86000	0				+++		0
8	O I D 56 1	1			0	+++		8.8
8	O I D 7 107	45			8			0
8	O I D 7 1 8	7			1	+		8.7
8	O I D 85 88	34		++	1			8.8
84	O P D 87314	8			15			8.8
85	O P D 5 08		3		0			8.8
86	O P D 87157	4	5				+++	8.8
87	O P D 7915	18			5	++		0
88	O P D 8944	5			1 t m p l	++	+++	8.8
89	O I D 861 8	8			N g		++	8.8
9	O I D 874 1	11	4		1	+++		8.0
9	O I D 785	40			1 t m p l			8.8
9	O I D 81 87	7			1 g t r		+++	8.7
91	O P D 87 0	5		++	2			8.8
94	O I D 87436	3			1 g t m	+		9
95	O I D 8466	7			7	+++	++	8.7
96	O P D 807 7				1 g t r	+++		8.8
97	O I D 87510	11	0		1			8.0
98	O P D 87544	0			1			8.7
99	O P D 84745	5			4	+		8.6
99	O P D 7935	38				++		8.9

1ge On patients aged 19 to 30 years we made 56 observations on those aged 31 to 40 years 33 observations and on those aged 41 to 63 years 11 observations

Among the group aged 19 to 31 years the lowest value was pH 8.0 and the highest was pH 9.0 in 86 per cent of cases the values were above pH 8.5

Among the group aged 31 to 40 years the lowest value was pH 8.0 and the highest was pH 9.0 in 79 per cent of cases the values were above pH 8.5

Among the group aged 41 to 63 years the lowest value was pH 8.3 and the highest was

pH 9.0 in 91 per cent of cases the values were above pH 8.5

Parity On nulliparous patients we made 32 observations. Some of these patients were unmarried among those married the sterility was due to various causative factors most of which were in no way related to the cervix. The lowest value in this nulliparous group was pH 8.0 and the highest was pH 9.0 in 69 per cent of cases the values were above pH 8.5

Hypoplasia We made 11 observations on patients who showed definite hypoplasia of the pelvic organs. In this group the lowest

value was pH 8.0 and the highest was pH 8.8 only 45 per cent of these cases showed values above pH 8.5. While such a finding is suggestive we feel that the number of hypoplastic cases observed was too small to warrant any definite conclusions.

Menstrual cycle In 65 of our cases the day of the menstrual cycle was known. We made 14 observations on or before the seventh day, 19 observations from the eighth to the fourteenth day, 17 observations from the fifteenth to the twenty-first day, and 15 observations on or after the twenty-second day. Among the group observed on or before the seventh day the lowest value was pH 8.0 and the highest was pH 9.0 in 79 per cent of cases the values were above pH 8.5. Among the group observed from the eighth to the fourteenth day the lowest value was pH 8.0 and the highest was pH 9.0 in 79 per cent of cases the values were above pH 8.5. Among the group observed from the fifteenth to the twenty-first day the lowest value was pH 8.0 and the highest was pH 9.0 in 88 per cent of cases the values were above pH 8.5. Among the group observed on or after the twenty-second day the lowest value was pH 8.0 and the highest was pH 9.0 in 80 per cent of cases the values were above pH 8.5.

Endocervicitis In 35 of our cases there was definite endocervicitis of greater or lesser degree. Among this group the lowest value was pH 8.0 and the highest was pH 9.0 in 77 per cent of cases the values were above pH 8.5.

Viscosity of endocervical mucus In 1 case we noted varying degree of abnormal viscosity of the endocervical mucus. Among this group the lowest value was pH 8.0 and

the highest was pH 9.0 in 65 per cent of cases the values were above pH 8.5.

SUMMARY AND CONCLUSIONS

1 The vaginal reaction is ordinarily unimportant in relation to fertility and sterility. It is not always negligible however for in occasional cases an excessive vaginal acidity may cause sterility.

The cervical reaction is constantly and definitely alkaline ranging from pH 8.0 to pH 9.0 and being above pH 8.5 in about 80 per cent of cases.

3 The cervical reaction is not notably influenced by age parity the menstrual cycle endocervicitis or viscosity of the endocervical mucus.

4 The cervical reaction in pelvic hypoplasia may possibly be less alkaline than it is in normally developed cases.

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CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, EDINBURGH UNIVERSITY

GASTRO-ENTEROSTOMY

D P D WILKIE M Ch FRCS EDINBURGH SCOTLAND
P f o i S g i y Ed i b g b U c i y

THE operation of gastro enterostomy has after a long period of what may be termed established supremacy in recent years been subjected to a most searching criticism and in the case of some surgeons has been abandoned as a surgical treatment for gastroduodenal ulceration. It has long since been recognized that to employ this operation for the relief of gastric disturbances not associated with organic lesions in the stomach or duodenum is both foolish and irrational and can lead only to disappointment. It is however the unpleasant sequelæ which may follow its use in cases in which organic lesions are present that has led many surgeons to reconsider their attitude of confidence and complacency in regard to its use as the standard operation for duodenal ulcer. The occasional occurrence of a vicious circle believed wrongly I think to be now a thing of the past the ineffective control which it gives to a bleeding ulcer of the posterior duodenal wall but above all the incidence of peptic ulcer gastrojejunal or jejunal have combined to cast a cloud of suspicion on a surgical operation not long since regarded as one of the most beneficial in surgery.

It is often necessary to take stock carefully of our surgical practice and it is as essential to retain what is good as to eliminate what is proved to be bad. A sane conservatism which will not be stampeded by waves of passing fashion and the dicta of those who would be ultramodern in their outlook and practice is as necessary in surgery as in politics. If we consider the many tens of thousands of patients who date their restoration to comfort and to health from the day on which they underwent this operation we cannot but recognize that it has still a large field of usefulness and will have a permanent place in surgery. That a greater discrimination in the choice of the individual case in which it may suitably be employed is necessary is obvious and if we can but detect the factors which make for non success we may in time elim-

inate in great measure the failures while not denying the unquestionable benefit which the operation confers in the majority of cases of chronic duodenal ulcer.

INDICATIONS

For the old standing ulcer which has led to stenosis of the first part of the duodenum and as a consequence to dilatation of the stomach gastrojejunostomy is the most effective operation. For the recurring acute ulcer of the duodenum without appreciable stenosis but associated with marked gastric hyperacidity a gastrojejunostomy, while often most successful is less surely indicated and in my experience is better replaced by a gastroduodenostomy of the Eiselsberg or Finney type. As a supplement to the closure of a perforated chronic duodenal ulcer it is in my experience uniformly successful. In the treatment of gastric ulcer when used in addition to excision or cauterization of the ulcer the results are good in the great majority of cases. For bleeding ulcer of the stomach or duodenum it is an inadequate operation in many cases and a direct attack on the ulcer area is to be preferred.

It goes without saying that in all cases attention to foci of infection in the teeth, tonsils, appendix, or gall bladder is essential and no short circuiting operation can of itself make good neglect to attend to persistent infective foci.

In describing the operation of gastrojejunostomy which we employ, I shall try to illustrate in some detail certain technical points which we have found to be of value rather than dwell on points which are now more or less standardized for any gastro intestinal anastomosis.

PRE OPERATIVE TREATMENT

Any infected teeth which may be present are dealt with some weeks before operation. Two nights before operation a mild aperient is given the night before operation the bowel is washed

out and 2 hours before operation 20 ounces of saline with glucose are given per rectum. Only if there is pronounced gastric stasis or if malignant disease is suspected is the stomach washed out prior to operation.

OPERATION

Anesthesia In the majority of cases general anesthesia induced with chloroform or ethyl chloride and carried on by open ether is used. In weak subjects twilight sleep and local anesthesia supplemented if necessary with gas and oxygen are used. In all cases the outer border of the recti and the extraperitoneal tissue along the line of incision are infiltrated with a half per cent novocain to increase relaxation.

Abdominal incision In the majority of cases a vertical incision is made through the medial third of the right rectus muscle. In viscerototic subjects and in older patients in whom chest complications may be feared a mid epigastric incision with relief incisions in the anterior layers of both rectus sheaths is made (Fig. 1). The object of this is to allow of easy suture in the midline the suture line being relieved of the lateral pull of the oblique abdominal muscles. It has the further advantage in the patient with the narrow upper abdomen of allowing of upper abdominal expansion by breathing exercises carried out during and after convalescence. The closure of this incision is illustrated in Figure 6.

Assessment Before deciding on a gastro-enterostomy it is essential to determine first of all that the pre operative diagnosis was correct; that the ulcer is of the type suitable for the operation and that no other associated or independent pathological conditions co exist within the abdomen. If a duodenal ulcer with stenosis be found the lesser curvature of the stomach is examined for a coincident gastric ulcer (found in 15 per cent of cases) which must be dealt with according to its size and degree of penetration. If a large penetrating gastric ulcer be found a wide resection and usually a partial gastrectomy will be called for as the chance of malignant degeneration is a real one. If the gastric ulcer be small (less than 1 centimeter in diameter) local excision or cautery followed by gastro-enterostomy will suffice.

The gall bladder and appendix are then examined and if showing evidence of disease are removed. Believing as we do that gastroduodenal ulceration and gall bladder and appendix affections are intramural streptococcal infections and essentially the same in etiology surgical treatment if resorted to must take cognizance of the entire

field and deal as effectively as possible with all infected foci.

The state of the other abdominal organs having been ascertained and the desirability of a gastro-enterostomy established the next question is whether the ordinary posterior operation can be done. There are certain cases in which from the configuration of the mesocolon the distribution of its contained vessels its shrinkage from previous inflammation or widespread adhesions a posterior gastro-enterostomy cannot be placed satisfactorily and should not be made. In such cases it is better to do a gastroduodenostomy or an anterior gastro-enterostomy with a lateral anastomosis between the two limbs of the loop.

Choice of site for the stoma This constitutes perhaps the most important single factor in making for a successful operation. If the stoma be made as it so often is too far to the left on the posterior wall of the stomach it does not function properly when the stomach is full and does not give the duodenum the rest for which the operation is designed. The stoma should be placed on that part of the posterior wall of the empty stomach which lies directly opposite the commencement of the first jejunal coil. This can best be determined by passing two fingers of the left hand over the front of the stomach as it lies within the abdomen passing the thumb of the same hand over the transverse colon on to the mesocolon and grasping the stomach and mesocolon at a point just opposite the first jejunal coil which is located by the thumb and forefinger of the right hand. While the left hand still grasps the stomach the mesocolon is made to present in the wound and a vertical incision is made with a knife through it scoring the wall of the stomach at this the chosen site (Fig. 5).

The opening in the mesocolon It is imperative that this opening be adequate. In my practice I cannot claim to have had the immunity from vicious circle of which so many surgeons boast. I have had to operate again for this complication in quite a few cases. In practically every one the cause of the trouble has been found to be an inadequate aperture in the mesocolon. If the vascular arcade is not sufficiently roomy to give ready access to the posterior wall of the stomach it must be divided at its summit between ligatures to give greater room. This division if carefully made does not in any way endanger the blood supply to the colon. If in a stunted mesocolon the vascular arrangement does not permit of such enlargement of the arcade a condition met with in a few cases all idea of a posterior gastro-enterostomy should be abandoned and some other

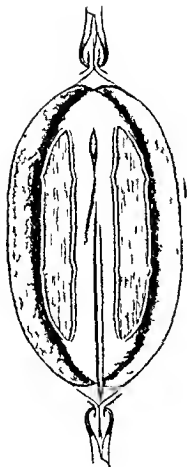


Fig. 1. Mid-epigastric incision. The relief incisions in the rectus sheaths have been made and the knife is now making the central cut.

procedure adopted. When the stomach is greatly dilated the tissues lax and the mesocolon expanded the edges of the rent in it may be stitched at once to the stomach wall well back from the site chosen for the stoma. In the average case however it is more convenient to adopt the method first introduced by Stiles of making an opening in the gastrocolic omentum bringing the first coil of the jejunum through the rent in the mesocolon and then through the omental opening and performing the anastomosis above the transverse colon (Fig. 3). The advantage of this method of access to the posterior wall of the stomach is most evident in short stout subjects but in practically all cases it diminishes the exposure of the viscera as the transverse colon may be returned within the abdomen during the next stage of the operation—the anastomosis.

The anastomosis. The vertical mark on the stomach is identified and is taken as the line of the stoma which is made in a vertical direction across the long axis of the stomach (Fig. 4). As a rule clamps (Lane's) are employed but in elderly subjects and in those in whom access is difficult it

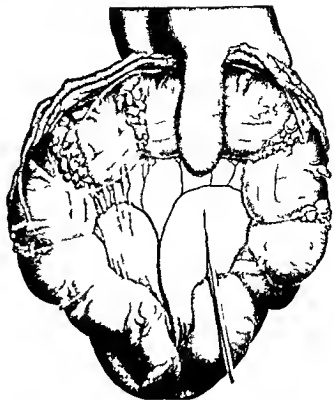


Fig. 2. Marking the site for the stoma by incising through the mesocolon into the stomach wall.

is often wiser to dispense with them a little hæmorrhage and possible soiling during the operation are less harmful than devitalization caused by clamps to tissues of low vitality or under great tension.

For the suture tanned catgut No. 00 on an eyeless needle is employed and three layers of stitches are inserted. Our custom for many years was to use but two layers but with the third layer less postoperative oozing is found. In elderly patients and in malignant cases a fine linen suture is used rather than catgut. I will not dwell on the individual suture lines more than to say that whatever method of suture be employed the object must be while controlling hæmorrhage to devitalize as little tissue as possible by light suturing.

Fixation of mesocolon. The anastomosis completed the jejunum taking with it the stomach is made to retrace its steps through the omentum and lesser sac of the peritoneum to its original position below the mesocolon. The edges of the rent in the mesocolon are grasped in forceps and fixed to the stomach three quarters of an inch from the seat of anastomosis by catgut or fine linen sutures which bite the submucous coat of the stomach and are then tied round the forceps as ligatures (Fig. 5). By this means inadvertent

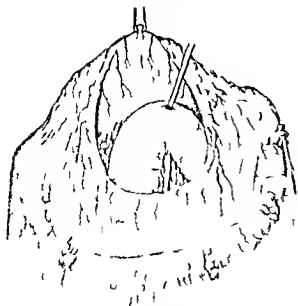


Fig. 3. The first of the four tension sutures is placed in the mesocolon and the jejunum is then replaced to the left in the incision made over the small intestine. A general L-shaped suture of gut is so placed as to invaginate the interior duodenal ulcer and increase the duodenal tension. This aids the healing of the ulcer and creates a temporary difficulty in the intestinal passage.

Fig. 4. The second of the four tension sutures is placed in the mesocolon and the jejunum is then replaced to the left in the incision made over the small intestine. A general L-shaped suture of gut is so placed as to invaginate the interior duodenal ulcer and increase the duodenal tension. This aids the healing of the ulcer and creates a temporary difficulty in the intestinal passage.

Fig. 5. The third of the four tension sutures is placed in the mesocolon and the jejunum is then replaced to the left in the incision made over the small intestine. A general L-shaped suture of gut is so placed as to invaginate the interior duodenal ulcer and increase the duodenal tension. This aids the healing of the ulcer and creates a temporary difficulty in the intestinal passage.



Fig. 6. The fourth of the four tension sutures is placed in the mesocolon and the jejunum is then replaced to the left in the incision made over the small intestine. A general L-shaped suture of gut is so placed as to invaginate the interior duodenal ulcer and increase the duodenal tension. This aids the healing of the ulcer and creates a temporary difficulty in the intestinal passage.

worm gut sutures the four tension sutures are tied over a roll of gauze

AFTER TREATMENT

On return to bed the patient is given heroin grain one sixth to ensure rest for some hours after operation. Ten ounces of saline with glucose (drachm one) are given per rectum every 4 hours. No fluid is swallowed by the mouth for 4 hours. As a rule the patient vomits some altered blood on one occasion on the day of operation. Further vomiting is taken care in location for washing out the stomach. The patient is kept on a fluid diet for 3 days and is given an alkaline mixture along with this. Soft solid food is given on the eighth day and the diet thereafter becomes more generous.

On leaving hospital on the sixteenth day the patient is given a diet high in and a prescription for an alkaline mixture containing belladonna. A careful regimen is a period of 3 months advised. Should heartburn or other evidence of hyperacidity be complained of during the first few weeks an intensive alkaline and atropin treatment is immediately instituted. Our experience has been that in quite a notable percentage of cases of jejunal ulcer following gastroenterostomy the

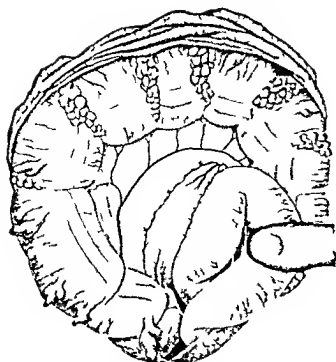


Fig. 5 The anastomosis complete and the edge of the rent in the mesocolon stitched to stomach well back from stoma

patients have complained of acidity and heartburn in the early days following operation. If the œsophagus is being irritated with acid the jejunum is probably suffering likewise.

Using the precautions mentioned above we find that gastro-enterostomy is a most valuable and gratifying operation in the cicatrizing ulcer case. Far from abandoning its use we feel that the experience of the last decade has led us to realize its extreme utility for a particular class of case and its unsuitability and inadequacy in others.

SUMMARY

1 For cicatrizing duodenal ulcer with stenosis gastro-enterostomy is still the operation of choice

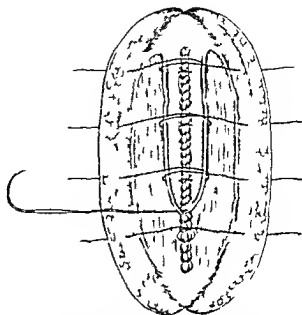


Fig. 6 Closure of abdominal wound. Four silk-worm gut figure of eight sutures in ercted Catgut suture which has closed peritoneum approximating the two sides of the spuncurotic ribbon

For acute recurring but not stenosing ulcer associated with marked acidity the operation is best avoided.

3 For gastric ulcer the operation is of value if combined with a direct attack on the ulcer.

4 Correct placing of the stoma is the most important point in the operation.

5 A free opening in the transverse mesocolon should be a *sine qua non* of the posterior operation.

6 The transomental route of access to the posterior wall of the stomach is recommended.

7 A midline abdominal incision of especial value in operations on viscerotonic subjects is described.

8 The very great importance of a period of dieting and alkaline treatment after operation is emphasized.

FROM THE GERMAN UNIVERSITY GYNECOLOGICAL CLINIC

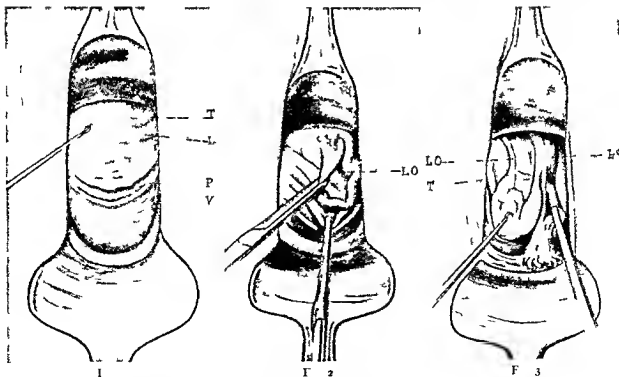
THE TECHNIQUE OF VAGINAL OPERATIONS ON THE UTERINE ADNEXA¹

PROF. DR. W. W. FIBEL, PRAGUE, CZECHOSLOVAKIA
 Director of the Gynecological Clinic

These so-called vaginal operations have very definite advantages over abdominal operations: the patients are spared the disfigurement of the abdominal incision; the danger of the operative procedures is materially diminished; the possibility of secondary healing and hernia formation is avoided; and finally, the period of convalescence is shortened. These advantages are especially important to the working woman. To be sure, there also exists a great disadvantage in that the technique is difficult and can be mastered only by much practice and years of experience.

The advantages of the vaginal operations are only of value if the proper selection of cases is made. Only such cases which can be faultlessly completed *per vaginam* should be selected. An

exploratory colpocoeleotomy is only rarely justifiable. It may be used to determine if an existing cyst is free of adhesions or if an adnexal swelling has been formed by a tubal pregnancy or a hydrosalpinx. The conditions govern the choice of cases for vaginal operations include primarily the free mobility of the adnexal swelling; that is, the absence of adhesions and the exclusion of the possibility of malignancy. The size of a benign ovarian cyst plays no special role if it is unilocular. Multilocular cysts can also be removed by morcellation if they are not too large. Dermoid cysts should not be removed vaginally as in their morcellation pulp and hair may soil the pelvic peritoneum and a thorough cleansing of it is impossible. It is not expedient to extirpate



1. Tubal pregnancy (T) and ovarian cyst (P.V.) being approached.
 2. Removal of tubal pregnancy (T) and ovarian cyst (P.V.) using forceps.
 3. Removal of tubal pregnancy (T) and ovarian cyst (P.V.) using a morcellator (LO).
 The diagrams illustrate the technique of vaginal operations on the uterine adnexa, showing the approach to the tubal pregnancy (T) and ovarian cyst (P.V.), the removal of the tubal pregnancy (T) and ovarian cyst (P.V.) using forceps, and the removal of the tubal pregnancy (T) and ovarian cyst (P.V.) using a morcellator (LO).

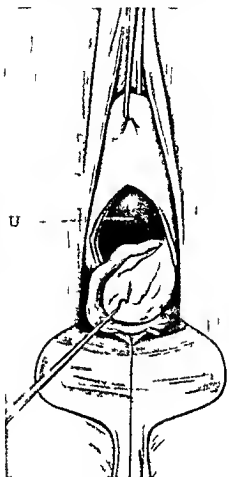


Fig. 4

Fig. 4 More complete exposure of the uterine appendages. U Posterior of uterus

Fig. 5 First steps in removal of tube

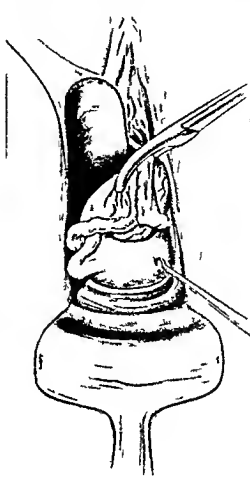


Fig. 5

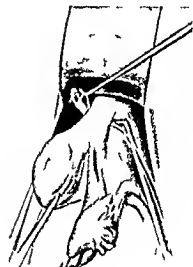


Fig. 6

Fig. 6 The ovary is drawn forward with a single tenaculum forceps the tube with an ordinary forceps until the infundibulopelvic ligament is stretched

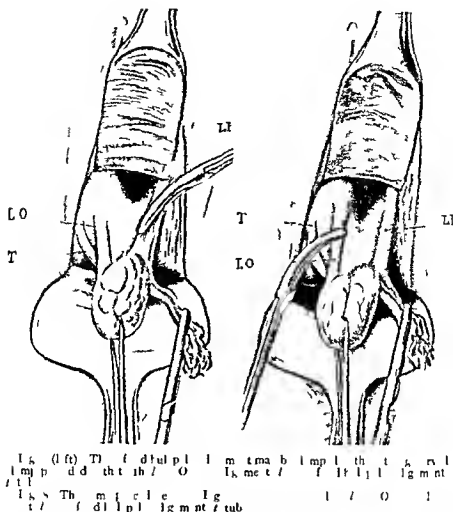
pregnant tubes by this route as they can be torn easily and are often limited in their mobility. If an hæmatocele exists at the same time it is always necessary to do a laparotomy. Existing inflammatory conditions even though chronic in nature (adhesions serious exudates and tuberculosis of the adnexa) contra indicate the vaginal route.

There are however a number of conditions in which the vaginal operation is the method of choice. The resection or extirpation of the fallopian tubes for the purpose of sterilization and the resection of a cystic ovary can be easily carried out through the vagina. No difficulties should arise in the removing of a moderate sized diseased ovary *in toto*. If through cystic degeneration it has become too large to pass through a colpopelvic incision it should be punctured. If this procedure proves that the ovarian tumor is preponderately solid or even suspicious of malignancy the vaginal route should be discontinued and the operation should be finished by a laparotomy. The experienced surgeon is sometimes

able to remove a pregnant tube no thicker than the thumb if it is not adherent and if there is no clotted blood in the pelvis. The desirability of leaving behind the attached ovary naturally makes the vaginal work more difficult. All of these conditions may be applied to the vaginal removal of a hydrosalpinx or hæmatosalpinx.

A further prerequisite for operating vaginally on the uterine appendages is a complete mastery of the technique of colpopelvicotomy. It may of course be done either anterior or posterior to the uterus. In the first place the bladder must be separated from the uterus before the plica vesico-uterina can be opened. This makes an anterior much more difficult than a posterior colpopelvicotomy because in the latter the abdominal cavity is entered directly through the posterior vaginal fornix.

The pre operative preparations for these vaginal operations are simple. Besides the customary disinfection of the vulva the vagina is scrubbed with tincture of green soap and then doused with a weak bichloride solution. The patient is



always catheterized just before the operation. The rectum is emptied by an enema on evening before operation.

TECHNIQUE

The opening of the abdominal cavity by the vaginal route is accomplished by means of either an anterior or a posterior colpocelectomy. The technique of colpocelectomy will not be described here. The latter route may be used for the resection or extirpation of the tubes or for the removal of an ovarian cyst, the lower pole of which reaches into the vesico-uterine space. The posterior route is to be preferred if the ovarian tumor lies in the pouch of Douglas. It may also be used as an aid to ligation as for example, in determining whether or not an adnexal swelling has been produced by a tubal pregnancy. Minor operation on the ovary and their enucleation may be carried out by either route.

The peritoneal cavity is opened by an anterior colpocelectomy, the latter is carried out in the following manner:

After the removal of the torseps from the anterior cervical lip, the portio is pushed back as far as possible with the finger. Then one ascends the anterior wall of the uterus by means of small delicate hooks, always keeping to the midline until the top of the fundus is brought into view. The fundus of the uterus does not have to be pulled into the vagina because such a procedure would make the manipulations of the adnexa unusually difficult and many times impossible. The little hook on the fundus pulls and crowd it to one side until the horn of the other side with the insertion of the round ligament and tube becomes clearly visible and easily approachable (Fig. 1). The hook is then removed from the uterus and the round ligament and tube become clearly visible and easily approachable. This makes the tube still more accessible so that it can be examined carefully by means of the anatomical forceps (Fig. 2). To bring the ovary into view the tube is pushed a trifle to one side and the

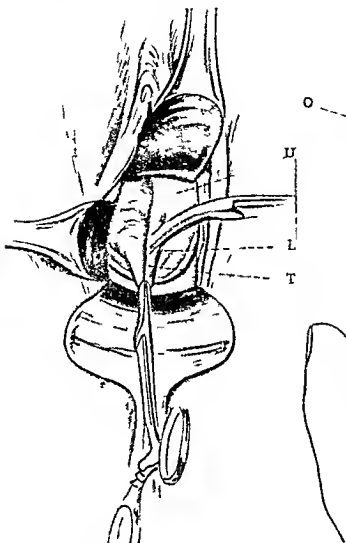


FIG. 9 (left) Curved lamp applied to uterine insertion of tube and forceps pulling down upon tube. U Uterus, L ligament, T tube.

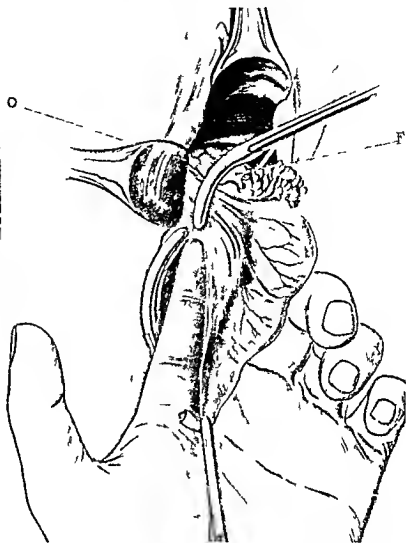


FIG. 10 Forceps placed on mesoalpinx. O is not to include the ovarian vessels in the upper ory ligament. O Ovary, F fundus.

ovarian ligament the insertion of which is to be found behind the tubal exit from the uterus is grasped with a forceps. Traction on this forceps pulls the ovary into view (Fig. 3). If the ovary with its tube is to be brought into the vagina the ovary is caught with a small hook and gentle traction is made the forceps at the same time being released from the ovarian ligament (Fig. 3). The ovary and tube now lie in the vagina and their pedicle bounded by the infundibulopelvic ligament laterally and ovarian ligament and tubal insertion medially is accessible on both sides.

If the pouch of Douglas has been opened through the posterior vaginal wall which procedure can be accomplished with a single stroke of the scissors the ovary is visible in the depths of the pelvis. The uterine appendages can be made more visible if the intestinal loops are pushed back by elevation of the pelvis or occasionally by in-

sertion of a hook near one of the uterine horns to pull down the fundus the forceps at the same time being removed from the cervix. The latter is not always necessary (Fig. 4). The ovary can be pulled forward by the insertion of a delicate hook. The tube usually follows *in toto* but if it does not it can be aided with anatomical forceps. The examination of the ovary and its resection or its extirpation which usually includes the tube are exceptionally easy procedures. For its enucleation delicately curved forceps with locked tips are used. The ligatures may be of silk or catgut.

Removal of an ovarian cyst is accomplished in exactly the same manner as will be described under operations by way of an anterior colpotomy.

Operations by way of an anterior colpotomy. The extirpation or resection of a freely

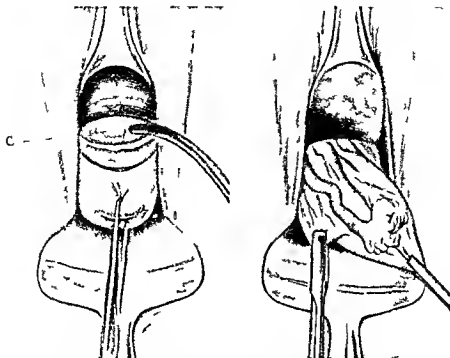


Fig. 1. If the lower pole of the cyst can be made fairly mobile by means of retractors, the most is held from above and pinched with a sharply bent tenaculum. Fig. 2. When the wall of the cyst becomes elastic, pull down the apex by means of a pinch heavy tenaculum. Its pedicle has become fairly accessible.

movable tube is easily performed by an anterior colporrhaphy. The fundus of the uterus is grasped with the small hook and is displaced anteriorly so that the one horn is brought into view. The tube becomes more and more visible and can then be drawn forward with the aid of two anatomical forceps as far as the infundibulum. The ovary usually follows it. The tube can be removed by beginning from the outside and working inward or vice versa. In the first place we begin by placing two delicately curved forceps on the infundibulum (Fig. 5) then the mesosalpinx is grasped with two more forceps the latter also including the tubal end if one does not prefer to excise a wedge shaped piece of the uterus containing the interstitial part of the tube. The deep wound made here is repaired in one layer with fine silk or catgut. However one may also begin by removing the tube from its uterine end with or without the wedge shaped excision. If the ovary is to be left behind the ovarian vessel must not be constricted with the first forcep on the suspensory ligament.

Occasionally another method of tubal resection may have to be resorted to. This is done by the insertion of two ligatures of fine silk which are placed several centimeter apart and by the excision of

the portion of the tube between them. This method should be used only if for technical reasons the extirpation of the whole tube is too difficult. In the resection the ovary is first fixed with a blunt forceps to the ovarian ligament. The abdominal end of the ovary is then grasped with a sharp hook or a Kocher forceps and with forcep and knife the diseased portion is removed. The wound is closed with fine silk or catgut.

The extirpation of the ovary itself will be considered only rarely as the attached tube is usually removed with it thereby making the procedure much easier technically. In the extirpation of the adnexa it is by no means advisable to pull the uterus into the vagina inasmuch as accessibility to the field of operation is thereby usually made considerably more difficult. In order to reach the adnexa it is necessary to fix the round ligament by a blunt tipped forceps then the tube and ovary are brought forward by gentle traction at the same time the forceps on the round ligament are released. Two methods may next be followed. One may begin with the infundibulopelvic ligament or with the uterine horn. The ovary is drawn forward with a single tenaculum forcep the tube is drawn forward with an ordinary forcep until the infundibulo-

pelvic ligament is stretched. This is illustrated clearly in Figure 6. The infundibulopelvic ligament is pierced from below with a Deschamps needle the thread being pulled out with a blunt hook and then tied (Fig. 6). Another method is to clamp the infundibulopelvic ligament with a strong curved clamp provided with teeth (Fig. 7). A second ligature if necessary even a third is placed on the broad ligament. The uterine tubal end and the ovarian ligament are ligated separately. The same procedure may be followed in the reverse order in which case the first forceps is applied toward the uterus (Fig. 8). The three or four ligatures are not to be cut immediately as they serve to pull the stump forward at the end of the operation so that it may be carefully inspected.

An enlarged tube (hydrosalpinx hemato-salpinx or a beginning tubal pregnancy) should be removed vaginally only if it is no thicker than the thumb and is nowhere adherent. Only under these circumstances can it be removed through an anterior colpotomy *in toto*. The operation begins with the removal of the tube from its uterine insertion. It is clamped with a curved forceps while another forceps is pulling it downward and outward (Fig. 9). A second and if necessary a third forceps is placed on the mesosalpinx until the last forceps is placed on the ligament (Fig. 10) so as not to include the ovarian vessels in the suspensory ligament. The ovary here is left behind unless it also is to be removed because of disease. It is not advisable to undertake this operation by way of a posterior colpotomy as the accessibility of the tube is essentially more limited than by the anterior route. An ovarian cyst with its lower pole in the posterior cul de sac should be operated upon by way of the posterior route. If on the other hand it lies in the vesico uterine excavation the cyst can be more easily extirpated by way of an anterior colpotomy. Finally it often occurs that a tumor is found high up in the false pelvis perhaps very movable on a long pedicle. One tries then under anesthesia to push it into the true pelvis. It is then removed either through an anterior or posterior colpotomy whichever proves to be the more accessible.

If the lower pole of the cyst can be made entirely visible by means of retractors the tumor is held from above and punctured with a slightly bent trocar (Fig. 11). The pressure from above is then stopped so that as little fluid as possible escapes into the pelvic cavity. When the wall of the cyst becomes relaxed it is pulled into the vagina by means of a special heavy tenaculum (Fig. 12) until its pedicle has become freely

accessible. The tube of course comes along with it. The pedicle is secured with several curved clamps or ligated directly by several ligatures. This procedure applies to an anterior or posterior colpotomy. If however the lower pole of the cyst does not lie in the true pelvis only the route anterior to the uterus should be considered. By means of a long forceps the round ligament is gradually pulled downward until the pedicle of the cyst becomes visible behind it. It can now be clamped by placing one forceps above the other as it is being pulled into view. The uterus is pushed back with a long retractor at the same time the pedicle is pulled downward until the lower pole of the tumor appears. This is steadied by means of traction on the pedicle forceps and pressure from above through the abdominal wall. It can then be easily punctured with the trocar.

The closure of an anterior colpotomy wound is made in the following manner. The peritoneum is completely closed. The vaginal incision however is only partially sutured. The space between the peritoneum bladder and uterus is drained for one day by a gauze strip. Here blood coagula may occasionally stagnate and fever may set in. If this occurs the cavity can be easily emptied with the finger or with an instrument. The posterior colpotomy is completely closed in one layer in uncomplicated cases. If adhesions which bleed are found in the cul de sac of Douglas or if the peritoneum has been contaminated by blood etc. the posterior cul de sac is drained by gauze or better still by a glass tube as thick as the small finger. This should be left for 5 or 6 days. The patient remains in bed 5 days after the operation.

The technique of an anterior colpotomy is not easy and a surgeon who has not had much experience with it will under certain conditions miss the right layer between the bladder and the uterus. If he keeps too near the uterus he will get no farther or in the reverse case he will invade the bladder. Injury to the bladder should be repaired in two layers with catgut and a retention catheter should be left in for one week. If the opening into the pouch of Douglas is made too far forward the peritoneum does not appear. The scissors detach it from the uterus more and more until finally the abdominal cavity is invaded far upward. If the incision is made too far posteriorly it opens the rectum. This is a far more unpleasant complication than an injury to the bladder. The repair of the injury by two layers of catgut covered over with vagina or peritoneum, and absolute rest of the intestines for 5 days are necessary for a smooth convalescence.

TREATMENT OF FRACTURES WITH THE EQUILIBRATED SWINGING TRACTION APPARATUS¹

DR. H. P. WIJNEN, AMSTERDAM, HOLLAND

S. S. F. I. D. W. No. 2, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94, 96, 98, 100

At present the traction apparatus devised by Dr. Metz of Amsterdam is known throughout the world as the Balkan frame, but none knows how the name originated. The fact is that Dr. Metz first used this frame in 1898 and described it in 1900. A Dutch ambulance unit brought it to Serbia where it drew the attention of the French and Americans and was adopted under the name of the Balkan frame. Later on it was mentioned by Blake, Grisey, Desfosses and Charliert and finally by Sinclair.

Figure 1 shows the original treatment devised by Metz for fracture of the femur. The frame shown was used for some time in the Coolsingel Hospital at Rotterdam by Dr. van Stockum. The patient sits on an elevation raised from 40 to 45 centimeter above the bed. Pillows stayed by wooden partitions which are omitted in the picture are placed at both sides of the patient and at his back. An adhesive plaster traction dressing with a modification according to Metz is applied in the usual manner. The essential part is then the suspension. The entire limb is suspended by a cord supporting thigh and leg separately. The knee is left free of bandage so as not to impede motion. A narrow flannel roller bandage is wound in a spiral around the traction dressing. Rings are fastened to this bandage. Each of the rings by itself is retained with two safety pins. One continuous cord is run alternately through the rings and through a row of pulleys in such a way that the cord begins at the most proximal and ends at the most distal ring. The lowest row of pulleys in their turn are suspended from a higher row of pulleys and the same in turn are suspended from one pulley placed still higher. The uppermost pulleys are supported by means of a cord which runs through two pulleys screwed into the wooden frame (Fig. 1). In daily use this apparatus is called a ship dressing.

Three factors contribute toward traction: (1) The weight suspended to the adhesive plaster strip. (2) The weight of the leg directed obliquely downward at an angle of 20 degrees. (3) The horizontal components of the forces acting upon the cord suspended in an oblique direction.

Without sufficient countertraction the patient would not be able to stand this traction. The countertraction is supplied by three factors: (1)

The uninjured leg upon which the patient may push himself off against a buffer. (2) Friction of the pelvis on the seat. (3) A woollen sling around the sound groin fastened to the head of the bed. This will cause the pelvis to take a somewhat oblique position so that the injured leg is pulled in abduction. With fractures of the thigh below the trochanters this position is of great value and an apparently insufficient abduction will in fact come up to the demanded requirements in all respects.

The sitting or semi-sitting posture possible with this arrangement is a great advantage especially for aged patients as it tends to prevent the development of pneumonia. In this position the hip joint is at all times in semiflexion. Nursing is much simplified because the patient soon learns to lean upon the well leg and is able at the same time to raise himself by means of the hand grip above his head. By means of active movements of the whole body such disagreeable and often life-endangering complications as pneumonia and thrombosis are prevented.

The row of metal rings fastened by the bandage may be transposed laterally so as to cause an inward rotation of the whole limb. By displacing the rings one can arbitrarily modify the rotation.

The part of the cord to which the leg is suspended runs distally in a more oblique direction than the part serving to suspend the thigh. This results in a slight bending of the limb at the knee. Metz' model was gradually modified by us so that the knee could be moved actively as well as passively.

After some time suspension by means of pulleys was replaced by suspension of the extremity to a long lath about the length of the whole limb. A row of small screw eyes was affixed to the side of the lath which faced the limb. The cord was laced through these screw eyes instead of through the pulleys. In this modified and simplified form the suspension and traction frame (with adhesive plaster strap) was used in Rotterdam for many years. Our next modification consisted in dividing the lath in two so that the thigh and the leg were each suspended separately to a shorter lath.

This measure was taken to procure greater

movement in the knee joint. The wooden frames were placed over and around the bed.

EQUILIBRATED SWINGING TRACTION APPARATUS ACCORDING TO NOORDENBOS

Different alterations of the original Metz suspension and traction frame gradually gave rise to the present equilibrated swinging traction apparatus according to Noordenbos. The wooden frame which was at first placed outside the bed was replaced by metal arches screwed upon the sides of the bed. At present we sometimes suspend the limb from a lath but more frequently we use one or two small hammocks for this purpose. The lath or hammock is no longer tied to the arch which is fastened to the bed. In order to make sure that passive and active motion will be possible to an ample degree the limb is brought into a swinging condition. The cord bearing the lath or the hammock is not attached firmly to the arch but is run on two pulleys, one end of the cord being fastened to the arch and the other end attached to a weight which will keep the limb in equilibrium. The limb is thus suspended in a swinging perfectly balanced position and an unlimited opportunity is afforded for motion. Generally two arches and two hammocks suffice to keep the leg in the swinging position. The pulleys are screwed upon the arches in such a way that the weight cannot possibly hit the patient if the cord to which it is suspended should accidentally break. One great advantage of this apparatus is that it can be made to fit any type of fracture and the patient together with his bed and the entire apparatus may be easily moved to a balcony, out in a garden or transported to the X-ray laboratory.

We have finally abandoned the use of adhesive plaster traction and have substituted direct skeletal traction with a nail according to the Codivilla Steinmann method. This has made it possible to reduce every shortening. Continued traction with relatively little weight has proved entirely sufficient but uninterrupted traction is of the utmost importance not only to attain correction of the shortening but also to keep the fragments in proper alignment.

For the treatment of fractures the validity of a method was at first judged according to the quantity of callus which was formed. Now we are convinced that an excessive formation of callus is undesirable. This extreme quantity of callus may be very injurious to the function of the limb either in a direct mechanical way by pressure on the muscles in the case of localization close to the joints or more indirectly by pressure

on the nerves or blood vessels. When the continued traction treatment is applied, callus luxurians is generally not observed and according to Bardenheuer, this phenomenon is to be imputed to the decrease of the interfragmental pressure. It seems reasonable that the proper reduction which generally comes about with this direct skeletal traction also has a part in the production of callus.

No other treatment permits the use of such a small bandage and allows so much freedom of motion. With nail traction the entire limb even at the site of fracture is uncovered and may be examined and palpated at any time. These advantages are due to the small point of application of the direct skeletal traction by means of a Codivilla Steinmann nail.

In general it may be said that the nail causes no pain at all or only slight pain even with active or passive motions of the injured limb.

Semiflexion according to Percival Pott is as indispensable to correct displacement as uninterrupted skeletal traction. Semiflexion is not only the position in which the flexors and extensors are in equilibrium but also the position in which the total strain of the flexors and extensors together is least. In physiological equilibrium the tube of the soft parts is circularly and equally stretched. When the shortening has been reduced by continued traction a lateral pressure which is conducive to a gradual reduction may be used.

In the position of semiflexion the total strain of the flexors and extensors is least so that a minimum weight is sufficient to reduce the shortening. The value of a position in which the limb swings freely but is fastened so as to hang on to one fixed point according to Sauter has been recognized for a very long time. We find it to be the next improvement in the Metz frame because here part of the serviceable effect is no longer lost through friction of the limb against the bed or a splint. Moreover a few however very slight, motions are possible. In the equilibrated swinging traction apparatus according to Noordenbos the active motions are possible to the fullest extent. Here no part of the dressing ever covers any joint. The whole limb is freely suspended and swings in equilibrium. The limb's own weight has been eliminated so that even the slightest muscle contractions cause some motion in the joints.

At the same time the suspension in narrow hammocks permits convenient nursing of the wound in compound fractures without the necessity of any changes in the swinging traction apparatus itself.

In view of our modern conceptions of the different requirements of the treatment of fractures such as the desirability of a good anatomical result and the possibility of active motion the equilibrated swinging traction apparatus is entirely satisfactory. It is needless to say that we do not mean by this that the anatomical result of all kinds of fractures may be called perfect. Neither is this in the least necessary for a good functional result. However a displacement so serious as to impede the use of the limb later on cannot continue to exist when this method is applied. One may also be told a great deal more care upon the encouragement of active motion and the execution of passive motion than was formerly possible. It is amazing to see how slight active motions may be executed only a few days after the application of the equilibrated swinging traction apparatus. The pain dependent on the fracture disappears almost instantly after traction is instituted. Simultaneously the shortened muscles are restored to their physiological length and the concentric pressure of the tube of the soft parts quickly causes absorption of the hematoma.

The swinging position and the slight active and passive motions made from the beginning of the treatment promote the circulation of the blood. Because of the continual traction active motions are soon possible and do not in the least endanger the retention of the fragments. As venous circulation is secured by the high position and suspension edema is practically prevented and the much dreaded complication of thrombosis is less likely to appear. The formation of scar tissue of the tender parts at the site of fracture will be minimized, atrophy due to inactivity cannot result and no stiffening of the joints occurs.

We point emphatically to the fact that active motion benefits the callus. Allison and Brooks compare a callus with atrophic bone. Active motion executed in moderation will not irritate the young callus and cause overproduction but will quickly cause it to ripen into bone. The amount of time required for bony union is not prolonged as our own experience has shown. At first we feared that the duration of treatment more especially the appearance of bony union might be prolonged by the execution of some active motion from the beginning but this fear proved to be unfounded. According to Blake and Schwarz the period in which bony union is accomplished is even shorter when active motions are executed than with immobilization. With this treatment the callus production is minimal but sufficient.

Care must indeed be taken to diminish the weight as much as possible as soon as the over riding has been corrected. With evident disastrous danger of delay in the bony union actually exists. With intra articular fractures early active motion is of the utmost importance. Immobilization in the case of hemorrhage in the joint will cause fibrinous adhesions which will at length become fibrous. Intra articular fibrous bands lead to bony ankylosis. Active motion however causes the blood to be absorbed quickly and keeps the joint in a supple condition.

The equilibrated swinging traction apparatus is of vital importance for fractures attended with vascular or nerve lesions. Its services were invaluable with our treatment of these dreaded forms of fractures. Traction and suspension with perfect balance are displayed to their full value and show themselves to be valuable therapeutic expedients in cases in which one has to treat serious disorders of the circulatory system or threatening paralyses.

The suspension of the injured limb in non constricting hammocks leaves scarcely anything to be desired. Therefore nowadays better results may be obtained than formerly for compound fractures with large wounds. Aided by scrupulous antiseptics we can with the equilibrated swinging traction apparatus treat the wound in many cases as though there were no fracture and reversely nurse the fracture as though there were no wound. While treating compound fractures we are no longer merely satisfied when infection and sepsis are prevented but we also require healing of the fracture with perfect anatomical and functional results.

The equilibrated swinging traction apparatus is simple and can be adjusted quickly. We construct the whole apparatus for equilibrated suspension and traction so that it is fixed to the bed. This makes it possible to move the patient out on a balcony or out of doors. When several patients with fractures are being treated it is wise to nurse them together in one ward. One patient then teaches another how to make active motions and a spirit of mutual encouragement prevails.

As the function of a limb may influence a patient's whole life the fact that the equilibrated swinging traction apparatus necessitates treatment in a hospital should not be considered as a serious disadvantage. From a social point of view the very best treatment is the least expensive because invalidity is prevented. Fractures should be treated with the utmost care in well equipped hospitals.

The possibility of infection through the Codivilla Steinmann nail is certainly not imaginary but with careful and expert handling of the nail the danger of infection is limited to a single exception if not entirely excluded. To illustrate this we mention the following laboratory experiment.

In patients treated with the Codivilla Steinmann nail cultures were made from the secretion of the canal. At the same time cultures were made from the bone and from the soft parts. These cultures all remained sterile. It was moreover shown by our experiments that the nail could be left in the bone for a considerable time if no infection occurred. The small wounds caused by the nail often heal in 2 days.

Doubtless a manifold control with roentgenograms is necessary with this method of treatment and makes admittance to a hospital for fracture treatment all the more desirable.

OUTFIT

We use practically the same instruments as devised by Steinmann. In Professor Noordenbos clinic small modifications have been made. In the first place a nail of rustless material is now used. It is quite as elastic and is scarcely impaired during the long period of traction. However the point of the nail sometimes bends while it is being introduced. The sharp point of the nail has therefore been made somewhat blunter but it retains its quadrangular shape (Fig. 2).

Linnartz advocates the desirability of giving a triangular shape to the nail point.

To introduce the nail according to the Steinmann method the handle chiefly is used. One piece nails are exclusively employed. The length of the nails varies from 0 centimeters to 5 centimeters with a corresponding diameter varying from 4 centimeters to 2 millimeters. The nail should project 2 to 3 centimeters outside the skin of the limb on both sides. To this end the diameter of the limb is measured with a pair of compasses at the spot where the nail is to be introduced. A nail of the desired length may then easily be selected. At present we have 4 different kinds of stirrups which fit these nails that is to say in addition to the original apparatus according to Steinmann there are three different sizes which correspond to the length of the nails. The fourth kind of stirrup is exclusively designed for nails that have to pierce through the distal end of the tibia. The blades of this apparatus are 5 centimeters longer and the long section is entirely straight. This gives ample room for the foot.

DISINFECTION

The whole limb is washed and shaved. The skin is separately disinfected along a zone extending circularly around the limb and 24 to 15 centimeters wide in proportion to the diameter of the limb at the site of the nail. A solution of 5 per cent picric acid in 96 per cent alcohol is used for the last disinfection. The area is then covered with sterile towels as for a major operation. The surgeon puts on a sterilized coat and rubber gloves. All the instruments are sterilized by boiling. In fact the whole procedure is carried out in a no less elaborate way than would be the case for a major operation.

ANÆSTHESIA

Preferably a general anaesthesia is used (ethyl chloride ether). In a few cases local anaesthesia may be applied when narcosis is undesirable. One should also bear in mind that with some patients the nail may be introduced without any anaesthesia.

INSERTING THE NAIL

While the nail is being inserted the hæmatoma at the site of the fracture should be carefully avoided on account of the danger of infection. Furthermore the nail must on no account be inserted through the medullary cavity but should transpire the spongiosa. Obviously the nail should be outside the joint and the capsule. It is of great importance to avoid the epiphysis so that growth disorders will not be provoked. Moreover the nail might gradually cut across without meeting with any resistance.

Large wounds or inflammatory skin affections are contra indications to the insertion of a nail. In such cases the nail will have to be driven more distally through the limb.

Different methods are used for driving the nail through the bone. When this transpiercing is done by means of a hammer the fragments may be shifted and involve the risk of spreading the hæmatoma. Besides it may be difficult to keep the desired direction. The nail may be caught in a hand drill or an electric drill. It is best however to use the handle and to bore the nail through the bone by hand. In case of considerable overriding one should retract the skin provisionally on both sides before introducing the nail so that it will exert no pressure upon the distal edge of the opening in the skin as soon as the shortening is reduced.

Previous incision of the skin and of the soft parts as far as the bone is not recommended. It was considered an improvement because the nail

would not come into contact with the skin when this incision was made. But if the incision is small, contact between nail and skin is almost unavoidable and if the incision is larger bacteria may penetrate the interior all the more easily from the outside along the nail because a breach remains. The previous drilling of a canal through the bone is a needless procedure not altogether devoid of danger. Since the bone drill is removed and the nail is then inserted the danger of infection is great.

THE NAIL BANDAGE

Around the two nail ends we apply iodoform gauze and then on top of this a small square piece of sterile gauze is tugged over the nail ends. This dressing is then fixed with a sterile bandage. The nail should be entirely covered by the bandage from the skin to the stirrup.

TREATMENT OF THE NAIL

An infection around the nail usually becomes manifest only after some time. Therefore it is improbable that the infection originates immediately after insertion of the nail when an accurate and aseptic technique is applied. The utmost care should therefore be taken during the entire treatment with the nail and the supervision should not be left to nurses.

Every week the bandage should be removed with sterile instruments and the skin surrounding the nail as well as the nail itself should again be disinfected. The small border of dried wound fluid around the nail should be carefully removed and the area cleaned with sterile gauze soaked in a solution of picric acid in alcohol. Then the nail is again dressed with iodoform and sterile gauze.

REMOVING THE NAIL

The stirrup and the bandage are removed with sterile instrument. All wound fluid is wiped off one of the nail ends at the same time the latter is thoroughly cleaned with sterile gauze soaked in the alcoholic solution of picric acid. The surrounding skin is also disinfected. After the picric acid solution has dried the entire procedure is again repeated.

Now the nail may be pulled out of the bone with tongs. In the presence of infection the nail is found to be entirely loose. Immediately after removal of the nail a small quantity of wound fluid is released. Thereafter both nail wounds are disinfected and covered with an antiseptic bandage. These wounds always heal quickly when no infection has appeared during traction. The infection of a nail canal is either the result of an

insufficiently antiseptic after treatment or of an error in asepsis during insertion and is of course avoidable.

Although infection is extremely rare and is founded on an error which might have been avoided with better care the danger of infection slight though it may be remains the weak point of the method. Yet it may be asked: Where in operative abdominal surgery does one find an unfailing method which never results in a disagreeable complication or warrants a mortality of 0 per cent?

However disagreeable a sinus after nail traction may be we should consider that the functional and anatomical results rarely leave anything to be desired. After all a sinus or what is worse a slight infection is more easily treated and healed than is an ankylosis, a shortened, an atrophy or a deformity. Besides the disorders which are liable to appear after osteosynthesis according to Lane are much more serious in their results than the slight inflammations of a nail canal.

Now we shall consider the application of the equilibrated swinging traction apparatus to different forms of fractures. The fracture that has caused much trouble in treatment throughout all ages is the fracture of the femur. We may justly consider the results of these fractures as our chief criterion for every method of fracture treatment.

FRACTURE OF THE FEMUR

The accompanying figures (3a and 3b) show how the patient is treated in a semi-sitting position. Here one recognizes a subdivision of Metz method which has been retained by us. This posture secures a semiflexion in the hip joint.

An elevation as wide as the bed and of a length of 60 centimeters and a height of 40 to 45 centimeters is placed on the mattress of an ordinary bed. Wooden partitions supporting the pillows against which the patient leans are placed behind and partly at the sides of this sitting piece. These partitions are caught between the head of the bed and the sitting piece; the partitions are connected by means of hook and eye. Two handgrips are suspended over the patient's head and fastened to an arch (omitted in the illustration) entirely similar to the arches to which the limb is suspended. The arches are screwed upon the bed. With the aid of these handgrips the patient may lift himself and at the same time lean upon the uninjured limb. During treatment this arrangement is of great value as it constitutes an aid in nursing and allows the patient to obtain general body exercise. Although the patient is

confined to his bed he need not in the least he quietly but may practice salutary gymnastics as much as he likes

For aged patients recumbency in an enforced position is thus entirely eliminated and life endangering complications such as pneumonia and thrombosis need not be feared. While the patient raises himself by his hands deep respirations must inevitably be made. The muscles of the abdomen and of the back seldom or never brought into action with other methods of treatment are used repeatedly.

The patient suffering from fracture of the femur is treated with a nail which is inserted supracondylarly according to the Codivilla Steinmann method. We however insert the nail from the medial side that is to say a finger's breadth proximally and a finger's breadth anteriorly to the adductor tubercle. While the nail is being inserted the angular displacement is reduced through manual traction on the foot. Meanwhile the limb is not flexed at all or only slightly at the knee. It is of the utmost importance to insert the nail perpendicularly to the axis of the thigh and not perpendicularly to the axis of the femur. The femur has an eccentric position in relation to the axis of the soft parts of the thigh. If the nail is inserted perpendicularly to the axis of the femur it will as soon as traction starts occupy a position perpendicular to the axis of the soft parts. This causes pain and a persistent angular displacement. Another disadvantage accompanying a faulty manner of inserting is manifested less distinctly that is the nail shifts its position gradually. The cause of this complication is generally not recognized. Therefore one often finds in the literature advice to slide small eses on both sides over the nail ends. These cases are made of cardboard wood or metal and rest against the bandage. As soon as the nail begins to move the apparatus fixed to the nail pushes against the case and the nail is stopped. In the most favorable instances the pressure of the case is painful and frequently results in ring shaped decubitus. Therefore these cases have been provided sometimes with a disk in order to distribute the pressure on the skin over a wider surface. At first we applied similar eses and disks but we have abandoned their use on account of the occurrence of decubitus. If the technique is faultless shifting of the nail does not occur.

Persistent angular displacement of the fragments also a result of a faulty mode of inserting the nail, may be combated by a separate and unequal strain at both nail ends (recommended by Sebeplmann, Linnartz, Baum, and others)

The essential feature of our method consists of the combining of continued direct skeletal traction with separate equilibrated suspension of the thigh and the leg.

To the foot of the bed a pulley is applied which can be moved along a vertical bar to any desired height. Over this pulley runs the cord to the apparatus fixed to the nail from which the traction weight is suspended. The limb entirely washed and shaved is first wrapped in sheet wadding and then covered with a flannel bandage extending from the toes to the knee the heel remains uncovered. Around this dressing is again carried the narrow roller bandage provided with rings. One ring is placed on the dorsum of the foot and five or more rings are placed on the leg. The desired degree of inward rotation is obtained by placing the rings more or less laterally (Metz). The rings are fastened with safety pins. If the limb does not show the least disposition to roll outward or inward the simplest manner of supporting the limb consists in the use of a small hammock. The ring dressing is applied in those cases in which a tendency toward inward or outward rotation exists.

Through the rings we lace one cord connecting the leg with a wooden lath provided with screw eyes. By means of a cord this wooden lath is connected with a weight exactly as heavy as the leg. Often the foot is kept up by a separate cord in order to prevent a talipes equinus.

The leg and the thigh hang completely apart on to two arches immovably fixed upon the bed. The thigh is suspended in a rough linen hammock. Two wooden laths each provided with two screw eyes keep this hammock in an expanded position. In order to prevent the formation of wrinkles heavy linen is used and its two upright sides are provided with exceedingly narrow iron splints. These splints are as long as the width of the hammock and continually keep the hammock sufficiently expanded.

For a long time hammocks have been used in the treatment of fractures. As far as we know Mojsosovics was the first to use a cloth hammock. To prevent the unequal and troublesome pressure of wrinkles he put a splint between the leg and the cloth thus obtaining a smooth bottom layer. However such hammocks will prove to be constricting after a time.

We employ two metal instruments just as long as or a little longer than the diameter of the extremity. These instruments are placed crosswise between the ends of the hammock and make of it a widely opened gutter so that no more than half the circumference of the leg at most will come into

contact with the hammock. Generally a folded towel sometimes containing a pad of cottonwool is put under the leg. The figures show how the hammock for the thigh as well as the lath or small hammock for the leg are suspended to a separate arch by means of a cord and pulleys. Both the weights to be fastened to the cord should be just as heavy as the thigh and the leg.

Now the whole leg has the agreeable and greatly desired position of semiflexion according to the cervical tilt. The degree of flexion of the knee and hip joint varies according to the seat of the fracture. The average flexion in both joints amounts to from 30 to 40 degrees. Besides in this position the distal fragment is brought in the axis of the proximal fragment after the classical precept. The patients may be encouraged to make active movements without danger. The pain warrants the execution of only gentle motion. Nothing is more conducive to obtaining a rapid bony union than these slight but frequently executed motions.

Uninterrupted traction assures success in the retention of the fragments in the reducing of the shortening and in case a nail is inserted perpendicular to the axis of the soft parts in the exact anatomical alignment (re-axiation) of the fragments. Our attempts to reduce lateral displacement entirely did not always succeed.

When the formation of callus begins the patient may somewhat increase the amplitude of his motions. The function already performed by the young callus promotes bone formation. Circulation is in no way impeded by the dressing and is stimulated by the active motion. This again has a favorable influence upon bone formation. We point once more to the great utility of active motion also from a psychological point of view. The patients have the feeling of being able to contribute to their recovery and the disheartening sensation of being ill and helpless in bed is not felt so keenly. The patient very quickly regains self reliance. His morale is most favorably strengthened by the continual increase of the degree of the excursions of the active motions and thus causes him to perceive progress subjectively. In spite of the long duration of the treatment patients remain cheerful and full of confidence in the future and in the method that enables them to contribute toward recovery. Every degree of increase in the amplitude of the motions is noted with joy and the patients are always anxious to demonstrate their progress. Active motions are not painful. If the contact of the nail with the soft parts becomes sensitive or painful we choose another point of insertion for the nail.

Massage is possible but generally superfluous while the patient is still in the equilibrated swinging traction apparatus. The hematoma is rapidly absorbed because circulation goes on under maximally favorable circumstances. Edema and a collateral effusion into the adjacent joint are also rapidly absorbed.

This apparatus satisfies the highest requirement for the entire patient is treated and not only a fracture complicated by a patient as was tersely expressed by Allison and Brooks in their criticism of the old immobilization method. There is no need of countertraction because of the light weights necessary to reduce the overriding with direct skeletal traction. It is sufficient that the patient may push himself off against the buffer with his sound foot. This buffer is a 40 centimeter cube placed at the foot of the bed. The foot of the bed has been elevated as was first indicated by Gurdon Buck. This measure is not so much intended for the exertion of countertraction as for the securing of a comfortable position for the patient.

The whole of the effect of traction benefits reduction. This is not only because the point of application is directly upon the bone but is also because the free suspension is perpendicular to the axis of the limb. This is not the case when splints or sliding splints are used.

For a fracture of the femur the nail may also be inserted through or just below the tuberosity of the tibia. For the long bones traction is usually applied directly upon the distal fragment in order to obtain an immediate effect. For fracture of the femur one has to use a different method. Christen pointed out the fact that traction applied to the condyles of the femur has an indirect point of application. Almost all of the muscles of the thigh are attached to the tibia directly distal to the knee joint. Thus the force necessary to pull the muscles of the thigh to their physiological length should be applied here. Then the distal fragment may be readily moved distally as they are unable to offer the slightest resistance. Relaxation of the capsule and ligaments of the knee joint cannot possibly result. Exactly the same reasoning may be applied to traction of the os calcis in fractures of the leg.

Although Christen's theoretical exposition may be perfectly correct we have found that traction with the tuberosity of the tibia as the point of application does not make it possible to reduce posterior displacement of the distal fragment. The same good results with the nail through the tuberosity of the tibia as the point of application are only obtained with fractures of the shaft of



Fig. 1 The original Metz apparatus

the femur. Figure 3b illustrates the apparatus for this kind of fracture. Fractures of the lower end



Fig. Drawing of nail

of the femur however require traction applied directly upon the condyles of the femur in order to obtain the desired elevation of the distal fragment.

How does this tally with Christen's thesis? When the knee is half flexed the condyles of the femur rest on the tibia only on their dorsal side (Fig. 4). These points of contact between the femur and tibia are dorsal with regard to the axis of the femur. The nail is inserted a finger's breadth in front of and above the adductor tubercle so that the point of application of the traction on the femur lies in the axis of the femur anyway ventral to the line connecting the points of contact of the condyles with the tibia.

As a result of traction upon the femur pressure is exerted upon the tibia. This will extend the muscles of the thigh to their physiological length. When all shortening is reduced the muscles will prevent further distal displacement of the tibia. Now the tibia has become a *punctum fixum* while traction upon the femur continues. The distal fragment of the femur now has a line of support passing the points of contact between the femur and the tibia. Ventral and proximal to the line of support a force is applied which acts in the

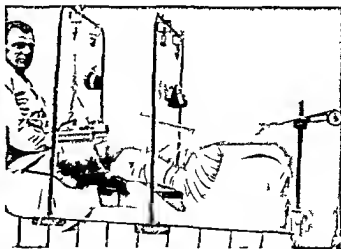
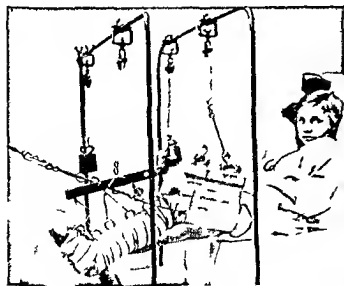


Fig. 3a and 3b Photographs showing how patient is treated in semi sitting position



Fig. 4. When the half flexed the distal fragment of the femur is in the only of the distal side

direction of femur axis. Then the distal fragment revolves in a sagittal plane and reduction of the posterior displacement results. The shorter the distal fragment the greater the effect obtained.

SUPRACONDYLAR FRACTURES OF THE FEMUR

If any doubt should still exist as to the efficiency of the insertion of the nail through the condyles of the femur the following case will demonstrate the superiority of the method which uses the condyles as the point of application of the traction.

I gave a patient the treatment of bilateral supracondylar fracture of the femur. The distal fragments were displaced posteriorly, the distal ends of the shafts of the femur were at an angle of 90 degrees to the proximal fragments. The patient was in a sitting posture and the fragments were held in position by the traction apparatus.

When the patient was in the sitting posture, the distal fragments of the femur were held in position by the traction apparatus. The patient was in a sitting posture and the fragments were held in position by the traction apparatus. The patient was in a sitting posture and the fragments were held in position by the traction apparatus.

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For children it is necessary to employ counter traction when both limbs are to be treated simultaneously in the equilibrated swinging traction

apparatus. The foot of the bed is elevated and on the mattress a padded sling retaining the pelvis is fixed (Fig. 6).

The boy shown in Figure 6 suffered supracondylar fractures but suspension of the thigh proved unnecessary. The method of treatment facilitated the nursing of the patient and also made it easy for him to move his entire body without detriment to the fractures. It is a well known fact that genu valgum (knock knee) is not to be detected in a flexed knee. Therefore the knee should not be flexed too much as one might unexpectedly meet with a consolidation in a valgus position.

FRACTURE OF THE FEMUR THROUGH AND BELOW THE TROCHANTERS

While treating fractures through and below the trochanters abduction and reduction of rotary displacement are of the utmost importance. In this position the distal fragment is put in the axis of the proximal fragment. Flexion of the proximal fragment is compensated by placing the patient in a sitting posture. Figure 7 gives a view of the equilibrated swinging traction apparatus for the treatment of fracture through the trochanters.

The arrangement in the bed is entirely similar to the arrangement for fracture of the shaft of the femur (Figs. 3a and 3b). A nail is inserted through the condyles of the femur. The leg is wrapped in a similar dressing but the rings are placed more laterally so as to obtain the desired inward (medial) rotation. The thigh is suspended in a narrow hammock, the knee being slightly flexed. We also use this narrow hammock for open fractures of the femur instead of the wide hammock (Figs. 3a and 3b).

Uninterrupted traction in abduction is obtained with the apparatus devised by Professor Noordenbos which is applied to the foot of the bed. The apparatus consists chiefly of three very long metal bars. Two of these bars of a round shape are immovably fastened to the foot of the bed at some distance from each other with catches and screws. Along these vertically placed bars a third bar placed horizontally may be moved up and down. The horizontal bar may be brought upward and sideways at the same time. Its end is provided with a pulley rotating around a vertical axis. With this construction any desired degree of abduction may be given at any height (Fig. 8). In our first apparatus the plane in which the pulley revolves made an angle with the bar regulating the degree of abduction (Fig. 7). The manner of attaching this pulley was soon improved and now it may rotate around a vertical

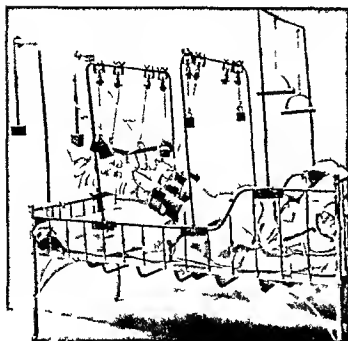


Fig. 5 Bilateral supracondylar fracture of the femur

axis. The desired position corresponding to the exact degree of abduction is now entirely automatically occupied by the plane in which the pulley is to move. With this apparatus any desired degree of elevation, abduction and rotation of the limb is possible for uninterrupted traction (Fig. 8).

For these fractures equilibrated suspension is of inestimable value. The limb may not only be flexed and extended but abduction and adduction are also possible to a large extent. Movements of the hip, knee and foot joints are in no way impeded. The wooden partitions partly visible in Figures 3a and 3b are entirely visible on Figure 7.

The sitting posture is indispensable for the treatment of aged and stout patients. By raising himself with the aid of the handgrips the patient causes all of the muscles of the body to function. At the same time deep respiration is stimulated. We treat very aged even 80 year old patients in this apparatus with excellent results.

FRacture OF THE BONES OF THE LEG

As Figures 9a and 9b illustrate the equilibrated swinging traction apparatus for an open fracture of the leg, we shall first give a summary of the treatment for open fractures and thereafter we shall pass on to a discussion of the treatment for fractures of the leg.

OPEN FRACTURES

Two kinds of open fractures are distinguished: primary open fractures in which trauma first



Fig. 6 Application of apparatus in bilateral fracture in children

lacerated the soft parts and thereafter caused the fracture and secondary open fractures in which the fracture existed first and thereafter the soft parts and the skin were wounded by the fragments from within outward.

Evidently the first group of open fractures affords the greater risk of infection.

Immediately after a patient with an open fracture is admitted the whole leg is gently but thoroughly washed and shaved. Before the treatment of the wound is started the patient is given an intramuscular injection of antitetanic serum.

We consider every accidental wound to be contaminated. If a macroscopic contamination is distinct we first administer a general anaesthetic. Then a solution of picric acid is poured into the wound and wiped off with sterile gauze. We repeat this until the wound is macroscopically cleaned. At the same time a sufficient debridement of the wound is made and in some instances excision of the contused edges is added. The vicinity of the wound is disinfected with an alcoholic solution of picric acid (5 per cent) then the wound itself is disinfected with fresh sterile gauze soaked in the solution of picric acid. This whole procedure is repeated.

The nail is then inserted. Generally it is impossible in these cases to insert the nail into the distal fragment of the broken leg. Therefore we use the calcus for the point of application. The nail is inserted a finger's breadth distal and parallel to the lateral malleolus through the os calcis. The nail is taken care of in the usual manner and everything is brought into readiness for traction.

Next the wound is covered with sterile towels and while a most careful asepsis is being observed all the shoe shreds are removed, the bone in so far as it has been microscopically contaminated is removed. The wound is again disinfected and the fracture then reduced. If the wound is large or if tendons and nerves are exposed coaptation of the ends is accomplished by means of a few sutures with catgut. If the wound is small however an antiseptic lanugo suffices. Figure 9a represents a patient with an open fracture of the bones of the leg. The nail according to the Codivilla-Steinmann method has been inserted through the calcus. Only a very light weight is needed to secure retention of the fragments. Suspension is exclusively achieved with the aid of hammocks as is usual for all fractures of the leg. Suspension is applied perpendicularly to the axis of the thigh and leg. Friction causing loss of part of the circulatory effect of the traction weight is prevented in all circumstances a small buffer gives little comfort a staff for the sound limb holds up all of the details of the apparatus in a fairly easy way.

Traction by means of the Steinmann nail is applied through the calcus just distal to the malleolus. The nail is placed in a small flannel hammock in front of the heel so that it free the heel of any pressure. The ring fastened to the hammock are kept up by a small clevis. This clevis avoids friction against the toe which may tend to be uncomfortable. A small cap again protects the heel from the toes. The application of a plaster bandage prevent the foot from falling, the plaster bandage is unnecessary. Nothing but traction with the use of the leg is to be compensated by the fastening in the bed in the position. The small hammock therefore supports the distal fragment. The proximal fragment is suspended by another small hammock. This together with the hammock of the thigh gives a fixed position to the knee.

By the hanging of the weights hanging on to both distal hammocks the transverse displacement (anterior) may be reduced. If the leg is not allowed to recurvate it may be corrected by pulling down the weight of the most

distal hammock or by finding another place for the hammock.

The wound (spiral and partly visible in Figure 9b) may be taken care of without any alteration in the equilibrated swinging traction apparatus. In fact it is now possible to treat the wound as if there existed no fracture and to treat the fracture as if there were no wound. The black color of the leg in the illustration is caused by the solution of picric acid.

Fractures of the leg in its proximal half are treated with a Codivilla-Steinmann nail inserted into the tibia. It is inserted from the side immediately anterior to the fibula and about four finger breadths proximal to the lateral malleolus. Fitting this nail we have a special apparatus in which the halves have been prolonged with a straight part.

ARTICULAR FRACTURES

The equilibrated swinging traction apparatus achieves its greatest success in articular and open fractures. The joint hemorrhage if not quickly absorbed will soon occasion fibrinous adhesions. With an immobilizing treatment these fibrinous adhesions are transformed into bands of fibrous tissue which will inevitably lead to ankylosis or arthritis deformans or at least to a certain stiffness of the joint.

As the results of the control examination will forthwith show the function of the joints is in no way impeded as a result of our method of treatment which includes early active and passive motions.

In treating a malleolar fracture of the leg we drive a nail through the os calcis and then proceed as in all fractures of the leg (Figure 9a). If a dislocation of the ankle joint should exist at the same time the occurrence of a relaxation need not be feared with this apparatus.

We treat fractures of the femur in which the line of fracture involves the knee joint with a nail through the distal end of the tibia. This applies to fractures of the femur as well as those of the tibia. For fractures of the femur the upper end of the tibia may also be taken as the point of application of the traction.

In order to maintain a good coaptation of the fragments in articular fractures of the proximal end of the tibia we sometimes employ a wooden caliper lined with felt. With the C-shaped fractures the condyles of the tibia are very much prone to separate laterally. If during the first day we apply this wooden catch which keeps the fragments in close apposition they will usually become durably fixed in the right position.

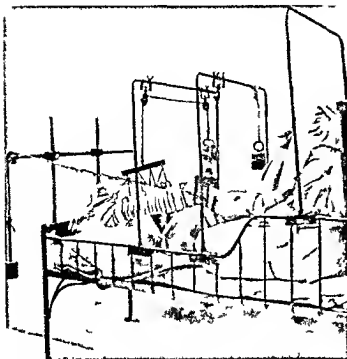


Fig. 7. Semi sitting position of patient with fracture of trochanter

FRACTURE OF THE HUMERUS

The treatment with a nail through the olecranon or through the ulna 1 inch distally to the olecranon (Fig. 10) is applied by us for fractures of the shaft of the humerus when reduction is not otherwise possible or when disorders of vessels or nerves occur. The illustration shows the humerus being suspended in the dressing with rings. At present we prefer to use a small hammock because it is much simpler and leaves the arm almost entirely exposed for examination. The forearm has been flexed to a right angle at the elbow and is kept in an upright position because the hand is hung in a handgrip. This position is as simple as appropriate. Padding around the wrist is maintained by a circular wristband fastened to the handle laterally from the hand by two loops. (Edema of the hand is prevented by active motions of fingers and hand. Movements of finger, wrist, elbow, and shoulder joints are in no way impeded. When the patient gets too tired to hold the handle any longer, the lateral loops provide suspension.)

With fractures of the surgical neck in the presence of considerable displacement we bring the upper arm into abduction. The dressing is in the main very similar to the dressing for fractures of the shaft.

The highest requirements are imposed by the treatment of the supracondylar and diacondylar fractures. With almost absolute certainty we

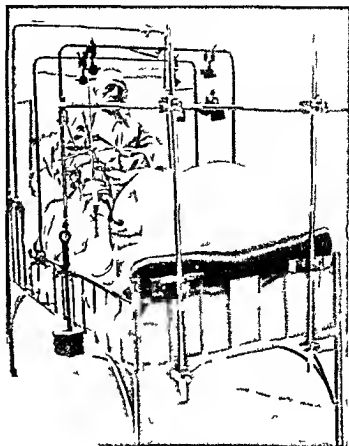


Fig. 8. The apparatus may be adjusted so that any desired degree of abduction may be obtained.

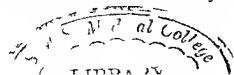
may warrant a very satisfactory reduction and function for fractures caused by flexion as well as for those occasioned by hyperextension. We always use the olecranon as point of application for the traction. For the rest the dressing is entirely similar to the dressing for fractures of the shaft.

The patients execute motions from the moment of application of the dressing. With fractures of the proximal half of the humerus we may also insert the nail a little proximally to the epicondyles in a frontal direction.

COMBINED FRACTURES OF RADIUS AND ULNA

When reduction is otherwise impossible we apply the dressing shown in Figure 11. Two nails are inserted: one into the olecranon and the other a little proximally to the distal radio ulnar joint. On the ulnar side 2 fingers breadth proximal to the styloid process of the ulna the nail is inserted through the ulna and radius with the forearm in semipronation. We attach to this nail the usual apparatus which has been provided with a handle by means of bronze aluminum wire, cotton wadding and a roller bandage.

The wrist band (Figure 10) is simpler than the



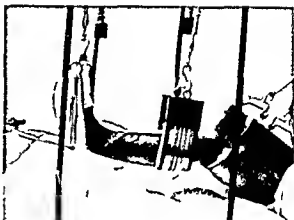
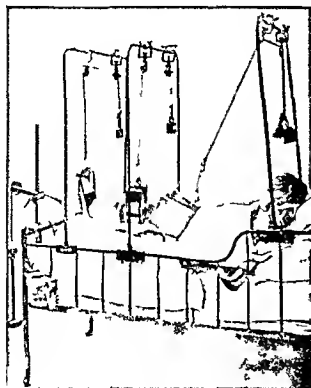


Fig 9 Fract of bones of lo c t b Detail of F e a

lital nail and just as effective. The so called parry fracture of the ulna associated with a luxation of the radius is treated in exactly the same manner. The traction in the right direction keeps the head of the radius automatically reduced and also maintains the fragments of the ulna in perfect anatomical apposition. Beginning on the first day the patient is urged and encouraged to execute active motion.

While treating an articular fracture of the proximal end of the ulna in the presence of a luxation of the radius we successfully apply vertical suspension of the forearm exclusively to a nail a little proximal to the wrist but without traction upon the forearm. Retention of this luxation is only possible in this apparatus. In this instance pull is exerted by the very weight of the upper arm. The exceedingly extensive joint hemorrhage rapidly subsides and the function of the elbow is impaired only by a few degrees in extreme flexion and extension until the patient's dismissal.

INDICATIONS FOR THE USE OF THE EQUILIBRATED SWINGING TRACTION APPARATUS AND CODIVILLA TRIMANN NAIL

Fracture with considerable overriding of the fragment should in the first place be treated with the equiblated swinging traction appara-

tus because of the certainty of reducing all shortenings by means of direct skeletal traction. The bone is restored to its normal length within a short time. As soon as proof of this has been furnished by roentgenograms and the transverse displacement has at the same time been sufficiently corrected it is advisable to diminish the traction weight. Diastasis of the fragments should be particularly avoided.

Fracture of the shaft of the femur the touchstone of the validity of every method of treatment generally heals in the equiblated swinging traction apparatus without any shortening rarely with a very slight shortening. Complete reduction of the transverse displacement is not always successfully attained but this is of minor importance provided the fragments are in proper anatomical alignment. Generally a sufficient reduction of transverse displacement is obtained.

For true articular and intra articular fractures functional therapy is at least as important as anatomical reduction. The equiblated swinging traction apparatus satisfies both requirements. A few days after the application of the apparatus for fracture of the tibia involving the knee joint the painfulness entirely disappears and the patient may then start his active motion. The joint



Fig 10 Fracture of the humerus

effusion is rapidly absorbed and in proportion to the reunion of the fragments the motions in the knee grow more extensive

At present better results may be obtained by means of this apparatus than by former methods of treating open fractures. The cure of the wound is in no way impeded by the equilibrated swinging traction apparatus and the limb is accessible on its entire circumference. Examination, palpation and change of dressing are always possible. The use of non constricting hammocks renders superfluous any more elaborate suspension apparatus.

For fractures with comminution the prevention of shortening and the proper alignment of the fractured ends of the bones are of the utmost importance. We fulfill both of these requirements with uninterrupted skeletal traction combined with equilibrated suspension. The traction suspension method is most successfully applied for the treatment of spiral fractures. In these fractures the retention of fragments was formerly extremely difficult and even now many



Fig 11 Apparatus applied in compound fracture of radius and ulna

useless operations are often performed such as wiring of the fragments. Uninterrupted traction is a reliable guarantee for the maintenance of the proper coaptation. No fixation dressing is as reliable as uninterrupted traction and in the latter active and passive motion may be executed without endangering the reduction. In general any conservative non operative treatment is to be preferred to an operative treatment. For para articular fractures the best results are obtained with the equilibrated swinging traction apparatus.

We always succeed in applying semiflexion which is so desirable for these fractures. This treatment is of vital importance for fractures complicated by circulation disturbances or in junes to important nerves.

For compound fractures also this treatment is surpassed by none. Thus we have successfully applied the equilibrated swinging traction treatment to multiple and articular fractures of the tibia. One patient suffered several fractures of the same tibia which involved the knee joint as well as the ankle joint.

ULTIMATE RESULTS

This paper is based on a study of the fractures treated in the Binnen Gasthuis at Amsterdam with the equilibrated swinging traction apparatus according to the method of Noorlenbos during the period from 1920 to 1925. In this same period 177 fractures of the lower extremity and one arm fracture were treated in a different manner and without traction apparatus. In all 157 cases of fractures of the lower extremity and 49 cases of arm fractures were treated with the equilibrated swinging traction apparatus.

Of the patients with fractures of the lower extremity 127 reported for control examination and of these 88 had pull exerted by means of the Codivilla Steinmann nail affixed directly to the skeleton. In all the other cases traction was exerted by means of adhesive plaster, zinc glue or the suspension traction dressing according to von Volkman.

Of the patients with arm fractures 43 reported for control examination and of these 4 were treated with the equilibrated swinging traction apparatus. For 3 patients adhesive strapping traction was employed. For 16 traction was transmitted by means of a wire through the triceps brachii tendon.

It will be noted that an experiment was conducted in order to compare the different means of traction and it was indisputably evident that nothing but uninterrupted traction exerted directly upon the skeleton by the Codivilla Steinmann nail was absolutely certain to reduce shortening.

TABLE I —WEIGHTS IN KILOGRAMS
FOR TRACTION

	Ad	Child
Thigh	7	3
Leg	4	5
Upper arm	3	
Forearm	4	

TABLE II —DAYS REQUIRED FOR BONY
UNION

	Ad	Child
Thigh	58	37
Leg	60	42
Upper arm	31	
Forearm		

Table I indicates the amount of weight used with the method in which suspension and nail traction are combined with free swinging of the limb. The numbers represent the average obtained by our calculation. During the treatment

of each case the size of the weights was repeatedly changed.

When considering these numbers one should bear in mind that in most instances the weight for traction was considerably diminished after a few days as the shortening had been reduced. The correct amount of weight is indispensable in obtaining the precise degree of interfragmental pressure (Bardenheuer) favorable to the formation of sufficient callus. On the other hand complete separation of the fragments may prove fatal to the formation of callus. There may be a chance of delayed union. During the first days not only the weights serving for traction should be frequently varied but also the weights used for equilibrated suspension.

It is true that the average period in which bony union is completed for adults is longer than is generally stated but our records apply to serious fractures difficult to treat intrinsically which would certainly have required as much time when treated in any other way. They were open or articular fractures or fractures with disturbances of the circulation or fractures with a marked displacement. Comminuted fractures consolidate as rapidly as other fractures but now and then re-fractures occur. In general the period required for bony union is no longer than with any other method while the functional result is distinctly better (Table II).

Sometimes with fractures of the upper arm or forearm the apparatus is removed before the process of bony union is complete at the stage in which the fragments have only flexibly coapted. At that time there is no more risk of secondary displacement and the patient may for a short period be subjected to an after treatment with a plaster of Paris dressing or with a sling. Also we often omit any dressing. A long treatment in hospital if undesirable through circumstances may thus be prevented (Table III).

Our records would be a great deal more favorable but for the well known fact that patients receive payment from the State Insurance Office and aged patients especially are inclined to protract the period of after treatment longer than is necessary (Table IV).

FUNCTIONAL RESULTS

We distinguish unlimited good and poor functional results. An unlimited function of the limb shows no perceptible difference between the sound and the injured limb. If a slight difference exists we call the function good; if the deformity is measurable, visible or worse we call the function poor. In Table V compound and

MICROSCOPY

The celloidin sections of the os calcis showed bone spicules separated from each other by adipose tissue. No accumulations of lymph corpuscles or leucocytes were found anywhere in the section. The bone spicules were typically constructed and arranged actiniformly around a circular spot almost in the center of the section and measured 3.5 by 3.5 millimeters. On the surface of these bone spicules was found a substance which was stained intensely red with eosin. This

we considered as osteoid. We also found a close meshed network of connective tissue abundant in capillaries and also containing a few lymph corpuscles. The nuclei of these connective tissue cells were partly round and partly oval. They had not been strongly stained with hematoxylin. Between the cells there was a fine fibrillar medullary substance. Toward the center the tissue became more loosely meshed and then gave an impression of adipose tissue. No signs of inflammation were noticed at the circumference of the circular spot (central).

B I F W M J V f h p h i J A my Labo J

FRACTURES OF THE LATERAL TUBEROSITY OF THE FIBIA WITH DISPLACEMENTS OF THE LATERAL MENISCUS BETWEEN THE FRAGMENTS

WILLIAM R. CUBBINS, B.S., M.D., F.A.C.S., CHICAGO

A P I S g y N h t U y S g Cook C y d W l y M m III p I

ARTHUR H. COMLEY, B.S., M.D., CHICAGO

R d S g e o F U J Cook C ty H f I

A D

CARNEY S. SHIFFERT, B.S., M.D., CHICAGO

R d S g F t C I Cook C y H p t a l

Fractures of the lateral tuberosity of the tibia have been known since fractures have been described, but it has seemed to us that such fractures occur much more frequently with the use of automobile bumpers—so fre-

quent have they become in fact that they might be called bumper fractures. Their frequency and the difficulty of obtaining good results with conservative methods have led us to try operative treatment with the result that we have found some interesting data in regard to the lateral meniscus in these cases.

Any force that will cause a sudden forced abduction of the extended leg can and frequently does cause fracture of the lateral tuberosity of the tibia. The anatomical reasons for the position of this fracture are that the tuberosity is shelf-like and is supported by the fibular head. On the other hand the lateral condyle has a short strong neck and its lateral edge is forced through the tuberosity by forced abduction of the extended leg.

The size of the fragment or fragments varies. The factors which cause this variation are not clearly understood. The entire lateral tuberosity may be crushed down and comminuted as is shown in Figure 1 or just a fragment may be broken off as is shown in Figure 3. In Figure 4 we see the lateral fragment completely separated from the tibia and Figure 6 shows a still wider separation of the lateral fragment. It must be obvious that rupture of the crucial or collateral



Fig. 1. (left) G. R. Cruikshank, lateral view of tibia. Fig. 2. (right) G. R. Cruikshank, lateral view of tibia. Fig. 3. C. R. Heide, lateral view of tibia. Fig. 4. C. R. Heide, lateral view of tibia. Fig. 5. C. R. Heide, lateral view of tibia. Fig. 6. C. R. Heide, lateral view of tibia. Fig. 7. C. R. Heide, lateral view of tibia. Fig. 8. C. R. Heide, lateral view of tibia. Fig. 9. C. R. Heide, lateral view of tibia. Fig. 10. C. R. Heide, lateral view of tibia. Fig. 11. C. R. Heide, lateral view of tibia. Fig. 12. C. R. Heide, lateral view of tibia. Fig. 13. C. R. Heide, lateral view of tibia. Fig. 14. C. R. Heide, lateral view of tibia. Fig. 15. C. R. Heide, lateral view of tibia. Fig. 16. C. R. Heide, lateral view of tibia. Fig. 17. C. R. Heide, lateral view of tibia. Fig. 18. C. R. Heide, lateral view of tibia. Fig. 19. C. R. Heide, lateral view of tibia. Fig. 20. C. R. Heide, lateral view of tibia. Fig. 21. C. R. Heide, lateral view of tibia. Fig. 22. C. R. Heide, lateral view of tibia. Fig. 23. C. R. Heide, lateral view of tibia. Fig. 24. C. R. Heide, lateral view of tibia. Fig. 25. C. R. Heide, lateral view of tibia. Fig. 26. C. R. Heide, lateral view of tibia. Fig. 27. C. R. Heide, lateral view of tibia. Fig. 28. C. R. Heide, lateral view of tibia. Fig. 29. C. R. Heide, lateral view of tibia. Fig. 30. C. R. Heide, lateral view of tibia. Fig. 31. C. R. Heide, lateral view of tibia. Fig. 32. C. R. Heide, lateral view of tibia. Fig. 33. C. R. Heide, lateral view of tibia. Fig. 34. C. R. Heide, lateral view of tibia. Fig. 35. C. R. Heide, lateral view of tibia. Fig. 36. C. R. Heide, lateral view of tibia. Fig. 37. C. R. Heide, lateral view of tibia. Fig. 38. C. R. Heide, lateral view of tibia. Fig. 39. C. R. Heide, lateral view of tibia. Fig. 40. C. R. Heide, lateral view of tibia. Fig. 41. C. R. Heide, lateral view of tibia. Fig. 42. C. R. Heide, lateral view of tibia. Fig. 43. C. R. Heide, lateral view of tibia. Fig. 44. C. R. Heide, lateral view of tibia. Fig. 45. C. R. Heide, lateral view of tibia. Fig. 46. C. R. Heide, lateral view of tibia. Fig. 47. C. R. Heide, lateral view of tibia. Fig. 48. C. R. Heide, lateral view of tibia. Fig. 49. C. R. Heide, lateral view of tibia. Fig. 50. C. R. Heide, lateral view of tibia. Fig. 51. C. R. Heide, lateral view of tibia. Fig. 52. C. R. Heide, lateral view of tibia. Fig. 53. C. R. Heide, lateral view of tibia. Fig. 54. C. R. Heide, lateral view of tibia. Fig. 55. C. R. Heide, lateral view of tibia. Fig. 56. C. R. Heide, lateral view of tibia. Fig. 57. C. R. Heide, lateral view of tibia. Fig. 58. C. R. Heide, lateral view of tibia. Fig. 59. C. R. Heide, lateral view of tibia. Fig. 60. C. R. Heide, lateral view of tibia. Fig. 61. C. R. Heide, lateral view of tibia. Fig. 62. C. R. Heide, lateral view of tibia. Fig. 63. C. R. Heide, lateral view of tibia. Fig. 64. C. R. Heide, lateral view of tibia. Fig. 65. C. R. Heide, lateral view of tibia. Fig. 66. C. R. Heide, lateral view of tibia. Fig. 67. C. R. Heide, lateral view of tibia. Fig. 68. C. R. Heide, lateral view of tibia. Fig. 69. C. R. Heide, lateral view of tibia. Fig. 70. C. R. Heide, lateral view of tibia. Fig. 71. C. R. Heide, lateral view of tibia. Fig. 72. C. R. Heide, lateral view of tibia. Fig. 73. C. R. Heide, lateral view of tibia. Fig. 74. C. R. Heide, lateral view of tibia. Fig. 75. C. R. Heide, lateral view of tibia. Fig. 76. C. R. Heide, lateral view of tibia. Fig. 77. C. R. Heide, lateral view of tibia. Fig. 78. C. R. Heide, lateral view of tibia. Fig. 79. C. R. Heide, lateral view of tibia. Fig. 80. C. R. Heide, lateral view of tibia. Fig. 81. C. R. Heide, lateral view of tibia. Fig. 82. C. R. Heide, lateral view of tibia. Fig. 83. C. R. Heide, lateral view of tibia. Fig. 84. C. R. Heide, lateral view of tibia. Fig. 85. C. R. Heide, lateral view of tibia. Fig. 86. C. R. Heide, lateral view of tibia. Fig. 87. C. R. Heide, lateral view of tibia. Fig. 88. C. R. Heide, lateral view of tibia. Fig. 89. C. R. Heide, lateral view of tibia. Fig. 90. C. R. Heide, lateral view of tibia. Fig. 91. C. R. Heide, lateral view of tibia. Fig. 92. C. R. Heide, lateral view of tibia. Fig. 93. C. R. Heide, lateral view of tibia. Fig. 94. C. R. Heide, lateral view of tibia. Fig. 95. C. R. Heide, lateral view of tibia. Fig. 96. C. R. Heide, lateral view of tibia. Fig. 97. C. R. Heide, lateral view of tibia. Fig. 98. C. R. Heide, lateral view of tibia. Fig. 99. C. R. Heide, lateral view of tibia. Fig. 100. C. R. Heide, lateral view of tibia.

ligaments may occur in these fractures but as yet we have not encountered this complication. If the head is crushed down as in Figure 1 the lateral meniscus is carried with it. If the lateral fragment is widely separated the lateral meniscus is sometimes detached at its curved border and displaced down between the fragment and the shaft in such a position that the parts cannot be approximated except by means of an open operation. The fluid in the joint is always bloody and contains a large amount of fat with fragments of cartilage and bone floating in it. These fragments of bone and cartilage have been found in the suprapatellar space. If the joint is opened 10 days to 2 weeks after the injury the free fat may give the fluid a purulent appearance.

The symptoms of this fracture are marked lateral mobility of the extended leg at the knee joint, fluid in the joint, a point of marked tenderness over the anterior portion of the lateral tuberosity, swelling and discoloration commonly, and crepitus usually absent. If the lateral tuberosity is fractured there is no increase in the motion of adduction—the increase is all in abduction. History of the injury is of value in making a diagnosis.

Roentgenograms in both the anteroposterior and lateral positions are essential to establish a definite diagnosis. For while the anteroposterior view would show this type clearly, it is not uncommon to miss a condylar fracture if only an anteroposterior view is taken.

TREATMENT

Unless the fractures are handled carefully the end result is a loose joint with a marked genu valgum which causes permanent disability.



Fig 4 (left) F M Fracture of lateral tuberosity separation of fragments.

Fig 5 F M Same patient as in Figure 4. Corrected with screw. Joint not opened. Apposition poor due as we believe to interposition of meniscus.



Fig 3 T M Slight fracture of lateral tuberosity. Treated conservatively. Excellent result.

Treatment may be of the conservative type if the separation is not marked. The fragment may be pushed into place if seen early or pounded into place with a soft hammer after the method

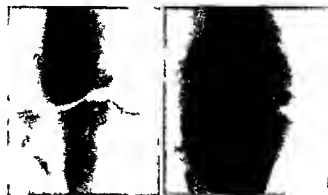


Fig 6 (left) G W Wide separation of lateral fragment. Operation. Joint opened. Meniscus located down between fragments. Meniscus removed. Fragments approximated.

Fig 7 G W Result of operative procedure to correct defect shown in Figure 6.

AN OPERATION FOR PILONIDAL SINUS

BY HENRY H. LAHEY, M.D., I.A.C.S., BOSTON

THE operative plan to be described in this paper has been successfully employed in this clinic for several years. It has also been demonstrated to many surgeons who report satisfactory results from its use. We therefore feel justified at this time in describing and recommending the operation as a means of completely ridding patients of the finger like branches of pilonidal sinuses together with the sinus itself and at the same time of making provision for the early closure and healing of the large deep defects which result from the excision of the sinus and its tract.

Some years ago in pilonidal sinuses I began to remove in a complete block all of the sinus tract together with all of the tissue around the sinus as shown in Figure 1. The purpose of this technique was to carry the excision of tissue wide enough and deep enough (down to the sacrum) to remove in one piece of tissue all of the diseased area with any of its ramifications. I was led to adopt this plan because of the number of patients who came back to us with recurrences following

less radical operations such as attempts by us and by other surgeons to follow sinuses and excise them.

The removal of a large block of tissue by this plan (Fig. 2) was very successful in that the sinus and its tracts were eliminated but such large defects remained that we were confronted with two great disadvantages: (1) Much time was required for the defect to fill in by granulation and organization and (2) a large mass of scar tissue was present directly over the sacrum where it was constantly subjected to pressure and trauma when the patient sat down and to lateral traction from the spread of the nates while the patient remained seated. As a result of this scar tissue being thus subjected to trauma we have several times seen it break down in different patients as well as become necrotic several times in the same patient.

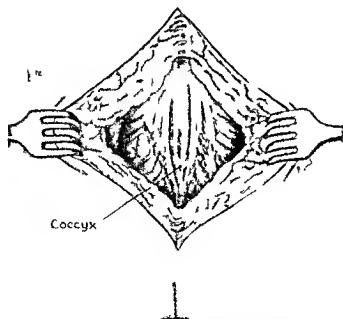


FIG. 1. The pilonidal sinus together with all of its ramifications has been removed in one block by the excision of the entire skin area over the sinus and by the carrying of the block incision down to the sacrum and out to the gluteal cleft. The sacrum covered with its aponeurotic fibers may be seen in center of wound and the depth of the wound and area to be filled with granulation can be appreciated.

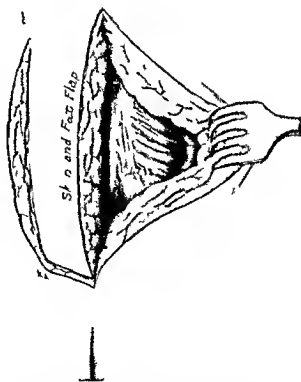
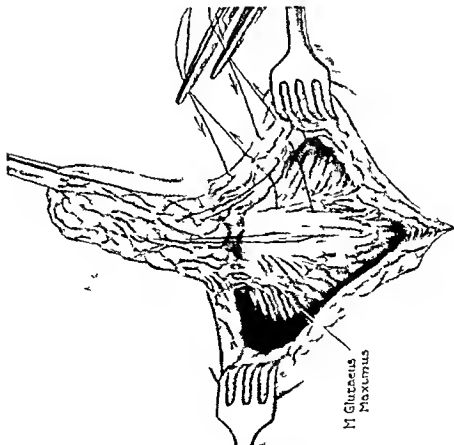
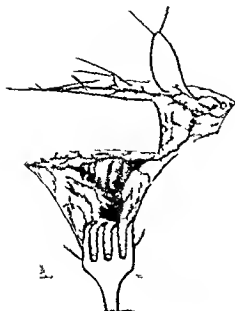


FIG. 2. The thick, broad based pedicle of skin and subcutaneous fat has been cut from one edge of the wound preparatory to transplanting medially and has been sutured to the opposite edge of the wound to fill in the deep defect left by the block removal of the pilonidal sinus and its tracts.



I 5 3



I 5 4

Fig 3. The illustration shows the maxilla and surrounding structures. The maxilla is the upper jawbone, and the surrounding structures include the maxillary sinus, the maxillary foramen, and the maxillary process of the maxilla. The illustration is signed 'A. C.' in the upper left corner.

LAHEY
CLINIC

Fig 5 The skin sutures have been inserted and this illustrate how the transplanted flap covers the defect over the sacrum. It also illustrates the character of the defect which is to remain and its very much lessened depth as compared with Figure 1 and the lateral and better location of the resulting cicatrix.

To overcome these disadvantages I have added a further step to the operation. I cut a fat lined skin flap with a broad pedicle from the side of the wound which is the result of the block excision of the sinus and transplant it into the center of the wound by suturing its internal edge to one edge of the wound leaving the opposite edge unsutured and with a wide defect in the remaining portion of the wound. The presence of this latter defect is of little disadvantage as may be seen in Figure 3 since the bottom of the cavity which now results is made up of the bulging fibers of the gluteus maximus muscle thus providing a soft yielding base for the scar which results following organization of the cavity and does away with the possibility of trauma to the scar which is produced by the solid sacrum when the scar is placed directly over that unyielding structure.

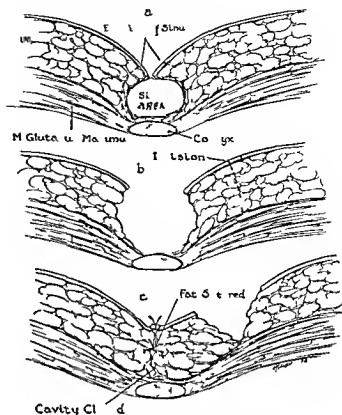


Fig 6 This drawing diagrammatically illustrates the plan of the proceeding. *a* Shows by the dotted line the proposed block excision of the pilonidal sinus and its ramifications which are diagrammatically illustrated by the white area marked sinus area. *b* Shows the deep defect which follows the block removal of such a large amount of tissue and the dotted line to the right indicates the proposed incision through skin and subcutaneous fat down to the gluteus maximus muscle which prepares the flap for transplantation. *c* Shows the flap transplanted to its medial position sutured to the aponeurosis over the sacrum and the subcutaneous fat of the wound edge and with the skin sutures in place. It also shows the lateral position of the defect which must remain and the advantage of having the defect in this position rather than in a median one.

SUMMARY

It is not claimed that the plan described makes possible healing by first intention for wounds produced by block excision of pilonidal sinus tracts. It does, however, greatly lessen the time of healing and greatly improve the character of the resulting scar.

The operation itself does not require written description as its steps may readily be grasped by studying Figures 1 to 5 with their legends.

INTRA ARTICULAR IMMOBILIZATION OF THE HIP JOINT

H. C. SCHUMM, M.D., F.A.C.S. M. WALKER, W. COSSIN
 (m h l) m () h p e d s e s e y l w c M l o n W

THE problem of obtaining a satisfactory immobilization of the hip joint has bothered surgeons for many years. The intra articular approach in the attempt to secure bony fusion between the head of the femur and the acetabulum was and probably still is the method most frequently employed. However the results with this method have been anything but satisfactory due either to the youth of the patient and the consequent lack of ossification or to the pathological process present both of which seriously interfere with bony fusion.

In 1911 Maragliano was the first to call attention to another method for immobilizing the hip. He employed a bone graft between the trochanter and the crest of the ilium. This extra articular method of throwing a bony bridge from the femur to the ilium was not widely known or used until 1917 when Allce (1) began using an extra articular method in which he placed two tibial grafts from the greater trochanter to the crest of the ilium. About the same time Kappis (5) in Germany reported a series of 8 cases in which success followed the placing of a graft between the trochanter and middle of the ilium. He considered his results as good when using dead bone grafts with autogenous graft.

In 1917 Baron (2) described an operation in which a flap of ilium 40 centimeters square was turned down over the hip joint and a flap of femur with its base at the greater trochanter was turned up to meet it. With this operation an occasional tibial graft had to be added.

Since then numerous surgeons of all countries have advocated the extra articular or para articular methods of hip immobilization and have devised various procedures. The most popular as well as one of the most efficient methods is that which was devised by Hibbs (4) and Hass (3) in 1918. In this method in which the greater trochanter is utilized to obtain fusion between the neck of the femur and the acetabulum. This method however is not strictly extra articular as the capsule of the joint has to be opened in order to reach the neck. The effect of the pathological process is thus brought into more intimate contact with the field of operation. However this is a theoretical rather than a practical point against the operation. Mathieu and Wilmoth (6) classify this method as a para articular and not as an extra articular

fusion. Another type of para articular fusion is that described by John C. Wilson (9) in which a flap of ilium is turned down and fitted into a slot in the trochanter and femur.

The following ilio-trochanteric strut graft method that we have used in 9 cases since 1926 has given good results.

The patient is placed on the operating table on his unaffected side the leg on the affected side being supported in the position at which fixation is desired. The position of choice is a flexion of 30 degrees and an abduction of 10 degrees. If the hip is partially ankylosed in a position not exceeding a flexion of 30 degrees and adduction of 5 degrees we consider it as satisfactory and rather than run the chance of lighting up the infection in order to secure a slightly better position we leave it as it is. If the deformity is greater than a flexion of 30 degrees and adduction of 5 degrees a Cant osteotomy can be performed at the time of the fusion operation or preferably later.

The incision (Fig. 1) begins at a point about 3 inches posterior to and below the anterior superior spine of the ilium and is carried down over the greater trochanter and lateral aspect of the femur for a distance of about 12 inches. The underlying fascia is similarly incised and then by blunt dissection the fibers of the gluteus medius and underlying gluteus minimus are split down to the trochanter. The muscle is then retracted anteriorly and posteriorly so as to expose the capsule of the joint and the surface of the ilium overlying the joint care being taken not to injure the periosteum of the ilium.

With a 2 inch chisel placed longitudinally a large anterior and a large posterior flap are raised from the greater trochanter. Each flap remains attached at its base (Fig. 2). With a 1 inch chisel a flap is then raised from the ilium the chisel being placed about 3 1/4 inch above and parallel to rim of acetabulum. This flap should be about 3 1/4 inch long x 4 inches wide with base upward.

The distance from the base of the flap to the lower end of the flaps of the greater trochanter is then measured with a probe. The upper end of the lateral aspect of the femur is then freed from muscle without disturbing the periosteum and the length of the required graft is then measured off on the femur beginning about 1/4 inch below the trochanter. The graft should be in with about

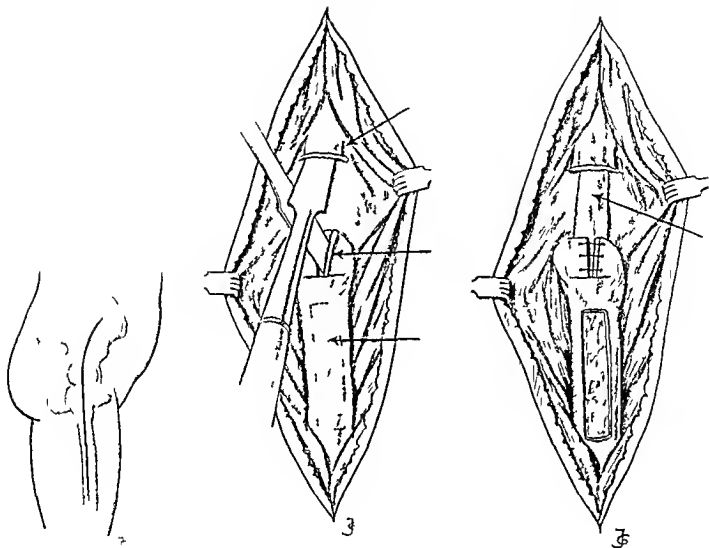


FIG. 1. Skin incision.

FIG. 2.

FIG. 3.

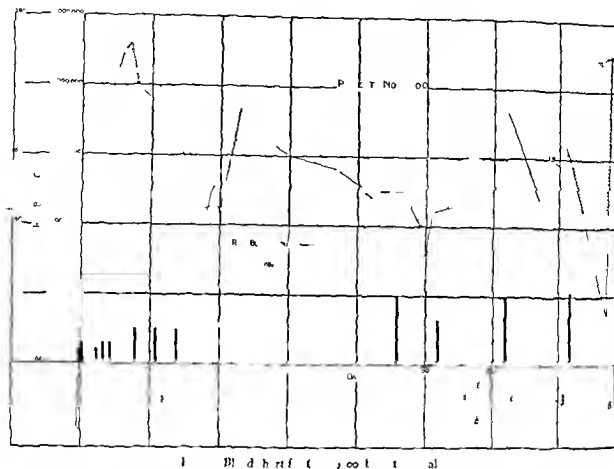
FIG. 1. Upper Flap from ilium reflected upward. Middle Flaps from trochanter reflected anteriorly and posteriorly. Lower Site from which femoral graft is removed.

FIG. 3. Femoral graft in place beneath flap of ilium above and with flaps of trochanter sutured together over lower end.

1/4 of the circumference of the femur and should be the full thickness of the shaft. It is easily cut out with a chisel; the electric saw is a rule not being necessary. We prefer to take our graft from the femur rather than elsewhere, as it does away with multiple incisions; the curved femoral graft is stronger than the straight tibial graft, and in none of our cases has the femur been weakened. One end of the graft is pushed up under the flap of the ilium which firmly holds it in place.

The lower end of the graft is placed in the prepared bed in the trochanter and the flaps of the latter are then sutured together over the graft with heavy catgut (Fig. 3). The graft is so firmly held in place that there is practically no danger of displacing it. The muscles are then allowed to fall together over the graft; the fascia is sutured with medium plain catgut and the skin closed.

If a deformity does not have to be corrected at the time of operation, a bivalved cast is made before operation as advised by Hibbs. It is removed and dried so that immediately following the operation the patient can be placed in it. This reduces the time that the patient has to be under the anæsthetic, provides a dry, warm cast and hence reduces the chances of postoperative shock. Unless complications arise, the patient is allowed to remain undisturbed in the cast for 3 months. At the end of that time the upper half of the cast is removed, the wound is dressed, and X-rays are taken. The leg is massaged daily. At the end of 4 months a short hip spica or a brace is applied and the patient is allowed to be up on crutches. At the end of 6 or 8 months, depending on X-ray findings and clinical examinations, all support may be removed. During this entire period the



treatment two of these being carcinoma of the breast and carcinoma of the stomach. Two with metastases in the liver developed an ascites one being a carcinoma of the breast and the other the new cell carcinomatosis. The case of epithelioma of the hip developed encephalitis. All patients at times had varying amounts of albumin and casts present in the urine. Two breast cases had suppression of urine one with convulsions. There were no embolic accidents. The usual colic constipation and neuritis of lead patients were absent. Only one case the breast case was alive—had all of these symptoms. In this latter treatment was started.

All patients were taken with a rapid grave anemia the free iron 0.1 gram of cellidal level losing to 60 percent hemoglobin and a many as 500000 red corpuscle per cubic millimeter within a day wherein bisphosphoric granules also appeared. Concentrated solutions of lead brought the about much sooner or in 1 to day. The anemia which at time presented a high color index of 1 plus tended toward spontaneous recovery. If concentrate and kerr diet were of value in combating the anemia. Injections of

0.05 to 0.1 gram of lead in a case fairly well recovered from the anemia acted very sharply in reducing hæmoglobin and red cell it looked like an accumulated action.

Blod charts Figures 1 and 2 show the action of colloidal lead in reducing the amount of hæmoglobin and total red count in four of these cases.

One case of carcinoma of the breast treated with colloidal lead only one is alive and the definite metastases. This case is presented in view of the possibility that the lead in conjunction with high voltage X-ray and chemical amputation of the breast may have prolonged her life. Figure 3 shows the lesion before the lead treatment. Case started and Figure 4 shows the same lesion after lead treatment. Figures 5 to 10 show the lesion since the lead treatment was discontinued and after chemical amputation of the left breast and skin grafting was done. The other five breast cases died 1 month 2 months 3 months 4 months and 1 year 3 months after lead treatment was started. All the other cases died—the time indicated in from the beginning of the lead treatment the 4 patients with epithelioma of the cervix died in 1 week 1 month 3 weeks and 1

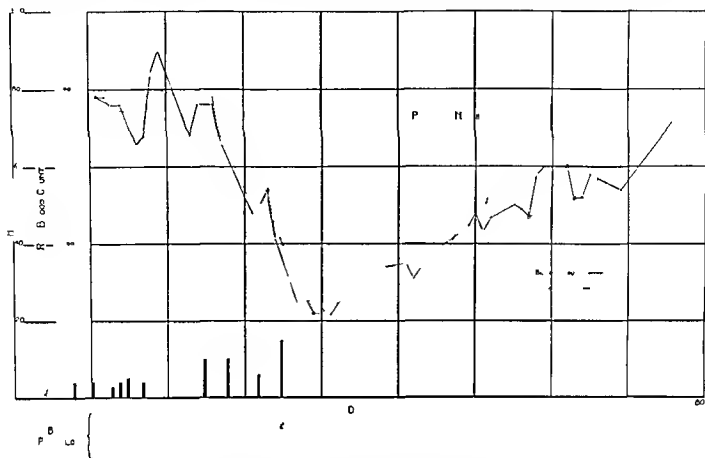


Fig 2 Blood chart for Case 8696 breast case died in 3 months

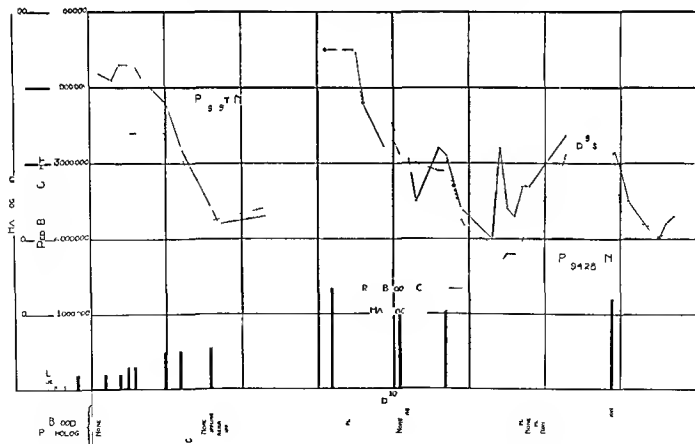


Fig 3 Case 9496 naevus cell carcinoma died in 4 months Case 938 epithelioma of lip died in 3 months



Fig. 1. Carcinoma of the stomach, 5 days after operation.



Fig. 2. Carcinoma of the stomach, 3 months after operation.



Fig. 3. Carcinoma of the stomach, 6 months after operation.



Fig. 4. Carcinoma of the stomach, 1 month after operation.



Fig. 5. Carcinoma of the stomach, 1 month after operation.



Fig. 6. Carcinoma of the stomach, 1 month after operation.

months one patient with carcinoma of the stomach died in 5 days the other in 3 months the patient with carcinoma of the bronchus committed suicide in 6 months the one with epithelioma of the larynx died in 1 month the one with epithelioma of the lip in 1 month the one with sarcoma cell carcinoma in 4 months the one with epithelioma of the penis in 6 months the one with osteosarcoma of the thigh in 3 months and the one with adenocarcinoma of the vagina died in 5 months

CONCLUSIONS

1. No clinical improvement in the tumor was noted in any case treated in this series.

Colloidal lead as used in the treatment of these cases produced a grave anemia

3. There was never hæmaturia observed in at least two cases treated with colloidal lead.

4. In our hands the lack of clinical improvement together with the severe anemias and asthenias produced by this form of treatment was cause enough for discontinuing the use of colloidal lead in the treatment of far advanced cancer.

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MULTIPLE GRAFT TECHNIQUE FOR EXTRA ARTICULAR ARTHRODESIS OF THE SPINE¹

By CHAPLIS MURRAY GRATZ M.D. NEW YORK

THE technique here described is of particular value for patients presenting extreme degrees of kyphosis in which arthrodesis is indicated. Arthrodesis is obtained by means of multiple overlapping bone grafts which induce fusion of the spinous processes and which later in cases of spinal tuberculosis promote fusion of the diseased vertebral bodies. Tibial grafts for this purpose were first employed by Albee who later devised the bent shingle technique which is the basis of the method herein set forth.

The tibial grafts are cut sufficiently thin to permit bending and adaptation to the pronounced curvature while the overlapping gives sufficient tensile strength to provide firm immobilization. The distance between the spinous processes varies directly with the amount of destruction in the diseased vertebral bodies and the technique described permits the employment of as many grafts as may be needed to meet the requirements of the individual case. In addition to the usual measures employed for fixation of the grafts the

trapezius muscles are overlapped when the operation is done in the dorsal region (see Fig. 10) thus giving greater postoperative support to the graft and obviating the need of any mechanical postoperative immobilization.

TECHNIQUE

Equipment. The only equipment required is the Albee motor bone saw and the usual stand and instruments for plastic bone surgery of this type.

Preparation of patient. In addition to the usual pre operative treatment of the patient on the night before the operation the part of the spine to be operated upon and the left leg are shaved cleaned with benzine painted with 3.5 per cent iodine solution and covered with a sterile dressing. On the morning of operation this dressing is removed the parts again painted



Fig. 1. X-ray view taken about 3 week after operation.

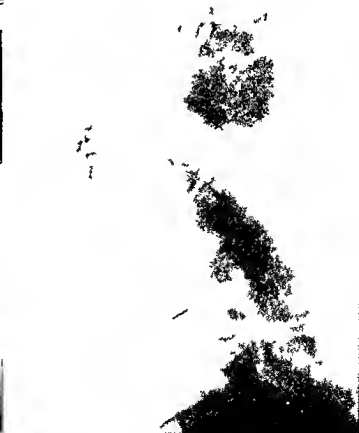


Fig. 2. X-ray view taken 19 months after operation.

P t d b f t h A l m e S o c t y f t h l f p t l f R p t d d C p p l d N w Y k C t y \ m b 9 8
S b m t t d f p b l t J l y 3 9 8



Fig 1

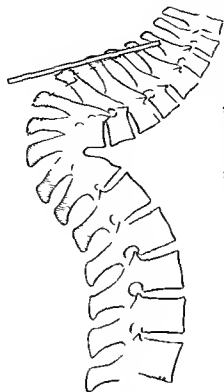


Fig 3

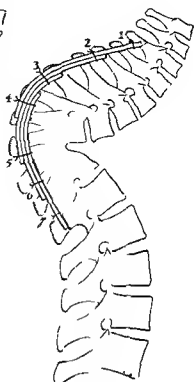


Fig 4

Fig 3 Section of the spine showing the location of the incision.
 Fig 4 Late level of the spine showing the location of the incision.
 Fig 5 The operative approach to the spine showing the location of the incision.
 Fig 6 Lateral view of the spine showing the location of the incision.



with iodine and covered with a fresh sterile dressing.

Operation. The patient is placed prone on the table and the operative area is prepared.

Incision is made extending from the third spinous process cephalad to the third spinous process caudal to the diseased area. The spinous processes are then exposed and split by means of a wide osteotome and mallet one side of each being fractured subperiosteally and displaced laterally to either right or left as the case may be. This technique should be carefully observed the result being a gutter about 1 centimeter in

Fig 5a, b, c, d, e, f: Lateral views of the spine showing the location of the incision.

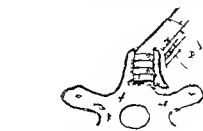


Fig 5g: Lateral view of the spine showing the location of the incision.

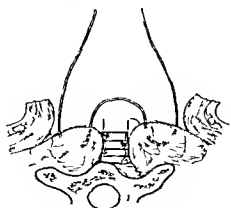


Fig 8

Fig 8 Vertical view between the spinous processes showing method of applying the sutures through the erector spinae muscles



Fig 9

Fig 9 Position of the erector spinae muscles after suturing has been completed

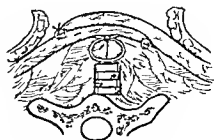


Fig 10

Fig 10 Method of overlapping trapezius muscle

width to receive the grafts (see Fig 7). The intraspinal ligaments are also divided by means of a narrow osteotome and mallet.

When this has been done the left leg is flexed, the skin and subcutaneous tissues are turned back, and with the aid of the motor saw five parallel vertical incisions are made in the central portion of the tibia in the order shown in Figure 5, the last two cuts releasing the grafts. This procedure obviates the difficulty that might arise by an attempt to remove each graft separately. It is of the utmost importance that these grafts be not more than 2 to 4 millimeters in thickness and 9 to 13 centimeters in length, varying with the age and requirements of the case, and that they should include all three layers of the bone.

It is easy to secure such grafts if the steps indicated in Figure 3 are followed.

The first graft is placed in the central portion of the superior spinous process at a little more than a right angle as shown in Figure 4, and is firmly secured in this position by a suture of kangaroo tendon. The position of this suture is shown in Figure 5a. The technique of passing this and subsequent sutures through the erector spinae muscles is shown in Figure 8, the trapezius muscles being reflected as shown. The position of the second and subsequent grafts and the sutures used for holding them in position are shown in Figure 5 a to f.

The mechanical principle of this succession of multiplex grafts is explained more fully later in

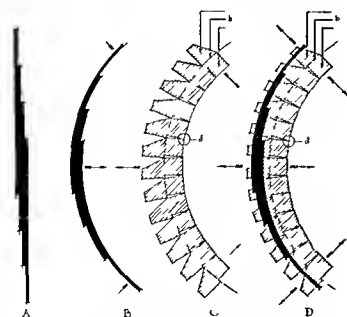


Fig 11 Tibial grafts in alignment as removed and balance of resultant forces after operation

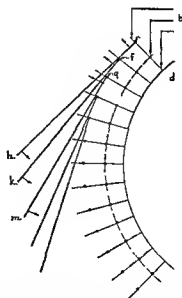


Fig 12 Diagram illustrating the method of attaching grafts to spinal column

interval but was not discharged because being an orphan he had no suitable home condition. The paroxysms were discharged intermittently until November 1919 and has not since recurred. X-ray examination May 1, 1928 showed a clear cut U shaped sigmoid body formed by fusion of the fifth to the twelfth thoracic bodies (Fig. 1).

The patient is now able to walk without support of any kind and has no pain. She was presented before the Queen's County Medical Society on May 17, 1918 and was at that time able to drive without discomfort from Suffern New York to Jamaica Plain and a distance of approximately 50 miles in an ordinary automobile.

SUMMARY

1 It will be noted that the grafts are taken from the central and not from the upper portion of the tibia the advantage being that in equal depth is secured for all the grafts whereas the increase in thickness of the cortex in upper portion of the tibia would produce irregularities.

2 The periosteal cortical and medullary surfaces are alternated thus insuring an even thickness and balance when the grafts fuse later.

3 The method of applying the grafts to the spinous processes the one beneath the other

gives a succession of leverages and besides results in the maximum thickness of the multiplex graft being placed opposite the point of maximum kyphosis.

4 The overlapping of the trapezius muscles prevents any tendency the grafts may have to straighten thus producing untoward postoperative complications. It also supports the back itself after the patient has resumed the erect posture thus eliminating any need for a postoperative cast or brace.

5 This operative technique may be varied as regards both size and number of grafts used to meet the requirements of the most extreme cases. It tends to check the development of the deformity and may even have a corrective effect. This is in contradistinction to any operative procedure in which the articular processes are destroyed which would tend to produce a slight increase in the kyphosis.

6 A modification of this technique may be used in selected cases of any marked spinal deformity.

ARTERIOVENOUS ANEURISM OF LEFT SUPERIOR THYROID VESSELS¹

JACOB M. MORRIS, M.D., Chicago

1110 S. W. 5th St., Chicago, Ill.

SINCE William Hunter (4, 5) first accurately described the clinical features of arteriovenous fistulae more than a century and a half ago such abnormal communications have been described involving most of the major divisions of the vascular tree. Nowhere however does there appear to be recorded an aneurism of the superior thyroid vessels such as occurred in the appended case. Reference to the larger series collected by Bramann (1), G. H. Minkins (7, 8, 9), Callander (2), and Reid (11) discloses no mention of involvement of these vessels.

The rarity of this lesion is particularly striking in view of the vast amount of thyroid surgery which has been done in the past decade. Indeed Lahey (6) and Pemberton (10) state that they have never seen an arteriovenous aneurism of the superior thyroid vessels. And Crile (3) writes that while he has never seen this complication following thyroidectomy, he has seen one case in which the aneurism developed subsequent to a polar ligature. Nowhere in surgical literature is it

mentioned as a possible complication of thyroidectomy or ligation. The following case therefore was deemed worthy of recording.

Mrs. R. L. Hou, wife 26 years old first presented herself in May, 1917 complaining of a small swelling on the left side of the neck. She was not positive as to the time this was first noticed but thinks she first became aware of it several days following a left lobectomy performed elsewhere in 1912. (The patient had had a right lobectomy performed by the same surgeon in 1917.) The swelling had begun to enlarge noticeably during the past year and while the patient was aware of the mass throbbing and pulsating it was otherwise symptomless.

Of significance in the past history was a syphilitic infection acquired in 1918 for which she had received vigorous antilutic treatment. Three pregnancies had occurred the first two terminating normally at term both children being alive and well at the time the patient presented herself while the third was a spontaneous abortion at the fourth month.

The central physical findings consisted of the presence of a small round swelling about 1.5 centimeters in diameter situated at the medial border of the left sternocleidomastoid muscle about 2 centimeters below the mandible. It was an expansile pulsating tumor with a distinctly palpable thrill and a systolic bruit transmitted downward

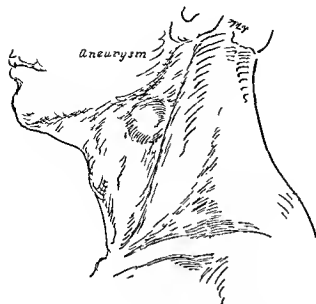


Fig. 1. External appearance and location of a curm.

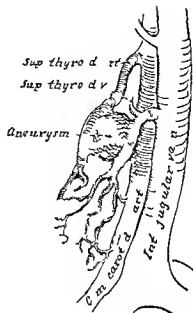


Fig. 2. Relation of a curm to vessel of neck.

along the course of the great vessels of the neck. The first part of the aneurysm was situated in the upper part of the neck, and the reflex was not too high. The blood pressure was 14-6, the urine was negative, the albuminuria plus 3, the blood Wassermann reaction was reported negative in the laboratory.

Operation was performed January 13, 1928, under the following conditions: The patient was in the supine position, the head of the table was elevated, and the patient was under general anesthesia. The aneurysm was found to be a large, rounded, and somewhat irregular mass, situated in the upper part of the neck, and the reflex was not too high. The blood pressure was 14-6, the urine was negative, the albuminuria plus 3, the blood Wassermann reaction was reported negative in the laboratory. The patient was discharged on the fifth day. The patient was followed up for six months after operation, and the aneurysm was found to be completely cured.

SUMMARY

A case of arteriovenous aneurysm of the left superior thyroid vessels is recorded. A searching review of the literature has failed to disclose a similar case. Despite the known history of

siphilis this aneurysm was probably of traumatic origin following a lobectomy on that side.

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THE PREPARATION AND MANAGEMENT OF THE DIABETIC SUBJECTED TO AMPUTATION FOR GANGRENE¹

BERNARD C. McMAHON, M.D., RUDOLPH SCHWARTZ, M.D., AND WALTER M. BARTLETT, M.D.
MORRISTOWN, NEW JERSEY
Fifth Phys. & C. I. 111

In a previous communication from this clinic (7) the general treatment of the surgical diabetic was outlined and three cases were reported. In view of the enlarged series it is thought desirable at this time to make a further report on the same subject including some of the changes made in management and technique. Since the opening of the surgical unit there have been more than one hundred operations on diabetic subjects. Thirteen amputations for diabetic gangrene have been performed since the initial report. Subsequent to the introduction of insulin in 1922 the mortality statistics reported by others (1, 3, 14, 20, 1) revealed a steady decrease in the operative risk in these cases.

PATHOLOGY

Von Noorden (19) mentions that all diabetics sooner or later develop marked arteriosclerosis and thereby become easily subject to the development of complications which arise from this arterial disease. Naunyn (16) on the other hand states that arteriosclerosis is not consequent to diabetes but that in many cases the primary arteriosclerosis may be responsible for the development of diabetes.

Allen (2) says: All cells of the diabetic organism are specially liable both to autogenous disorders and to external injuries as they lack the normal power both of burning food substances for energy and of building up and repairing their protoplasm in addition to being poisoned by products of abnormal metabolism. This is responsible for the more degenerative changes such as arteriosclerosis and dry gangrene and also for the deficient healing of wounds and the susceptibility to bacterial invasion.

Ehason (9) in his report states that gangrene resulting from this arterial disease is analogous to that occurring in diabetes but that in diabetes the gangrene is apt to develop about 10 years earlier than in non-diabetic subjects. Gangrene or the local death of tissue, is due to the shutting off of the blood supply to a part by some condition. The most common causes are thrombosis, embolism, infarction, ligation of vessels and obliterative disease of the blood vessels which in turn may be due to infections, poisons, injury

from heat or cold or electrical injury. Depending upon the nature of their etiology and the rapidity with which they have developed the necroses are either dark green, yellow gray, or black. For practical purposes gangrene is divided into two types: mummification or dry gangrene and putrefaction or moist gangrene.

In dry gangrene rapid evaporation of the tissue water occurs; the horny layer of the skin becomes brown, black, or leathery and is frequently as hard as stone. This type of gangrene occurring in the extremities of people with advanced arterial disease, is arteriosclerotic or senile gangrene and is prone to occur in diabetics. Moist gangrene results from a luxuriant growth of putrefying organisms of the colon bacillus, bacillus of malignant oedema, bacillus welchii or the pyocyanous types.

Since the initial report (7) several cases of dry gangrene have been observed which have healed without the aid of surgery as a result of treatment with strict diet and insulin. We now give all cases of this type the opportunity to heal in this manner if operation does not seem imperative. In cases in which the circulation in the foot is apparently sufficient and in which there are no signs of a spreading process we have been conservative and only when this has failed have operations been performed. Our results confirm those of DuPre (8) and Gray (10) in their excellent reports of cases treated non-surgically. In this series our experience agrees with that of Williams (2) that gangrene is rare in the insulin-treated diabetic. The rule is that gangrene develops in the neglected diabetic.

Without surgical intervention a local area of necrosis may be cast off and its place taken by new tissue regeneration; the defect may be filled in with connective tissue, cicatrization or the necrotic tissue may be cast off and leave an open ulcer showing liquefaction necrosis. There is always a reactive inflammation around the necrosis—the sequestration necrosis inflammation—which limits the necrotic area. When such an area is small it usually heals readily when proper treatment is initiated. Large necroses, especially those involving bone which form an osteomyelitis, cause much trouble unless surgical

intervention is early and adequate. If this is not done, fistulous tracts and sinuses will form open on the surface and discharge foul purulent material.

In all cases of gangrene excepting those of the benign type begin with pain in the part. This is thought to be an indication of thrombosis and not infrequently a thrombus is found at operation. As the arteries are severely diseased and their walls thickened and inelastic they are reduced in caliber. Gangrene is easily precipitated by a slight injury or chronic irritation from pressure which induces thrombosis of the smaller or larger vessel supplying the part. Buerger (4, 5) states that the vessels of limbs amputated for diabetic gangrene show a mortifying process due to extensive arterial disease. Joslin (11, 12) adds that in examination of diabetic limbs removed for gangrene shows the uselessness of trying to save most cases of diabetic gangrene from amputation. This is because extensive thrombosis and advanced arterial disease make healing impossible. Excellent reports on this general subject have been contributed by Joslin (12), Mason (13), Palmer (14), Cochrane (6) and Eliason and Wright (9).

INDICATIONS

There are certain absolute indications for surgical intervention in the treatment of diabetic gangrene which cannot be overlooked with impunity. Amputations of extremities for diabetic gangrene are not operations of choice but of necessity. The primary object is to save the patient's life. The physician or surgeon who allows his zeal for conservatism to influence him against a high amputation adds 35 or 40 per cent to the operative mortality in the event that reamputation is made necessary by development of secondary gangrene. Most of the cases come to the hospital in extremis with gangrene of the whole foot or the whole foot and part of the leg. They show signs of absorption and appear definitely septic. For these reasons temporizing measures are not successful in the majority of cases.

The positive indications for operation are (1) the presence of signs of a rapidly spreading process, (2) the presence of a virulent infection with signs of septicemia or exotoxemia and (3) the presence of a diabetic condition that can no longer be controlled by frequently repeated and increasing insulin dosage with proper dietetic treatment. Operation is performed without the slightest hesitation when any of the above indications are noted.

If such indications do not present themselves time is always allowed for careful observation and adequate preparation. During this period the diabetic condition is brought under thorough control and temporizing measure for the treatment of the gangrene are initiated.

SITE

In regard to the site of amputation the discussion is limited to diabetic gangrene. Simple infections are not regarded in this category. Formerly in patients under 45 years of age who had easily palpable pulsations in the popliteal and dorsalis pedis arteries the Stephen Smith amputation below the knee joint was favored. Although this operation preserves the knee joint it leaves the stump covered only by skin and fascia and does not prove satisfactory for weight bearing, after healing is complete. When this operation is performed in poorly nourished diabetic patients healing is apt to be slow and imperfect. Diabetic patients are particularly prone to develop pressure necrosis from the slightest irritation and secondary gangrene in these stumps is frequently seen. Even if the stump heals perfectly the proper function of the knee joint is disturbed by the mechanical difficulty of manipulating the short stump below the knee. These considerations have led to the adoption of the Stokes Gritti amputation. With this technique a better weight bearing stump is obtained, the stump is more easily fitted with an artificial limb and the artificial knee joint functions better than the genuine knee joint does following any of the usual operations below the knee. From this experience and that of Eliason (9) patients beyond the age of 60 will not use artificial limbs after they have been fitted but prefer to use crutches.

In patients over 45 years of age and in some younger patients amputation above the knee joint is preferred. When arteriosclerosis is far advanced especially when the amputation is imperative because of the patient's general condition it is best to amputate in the mid thigh or above. The main advantage of the high amputation are that (1) the operation can be accomplished quickly with the least loss of blood, (2) the healing is rapid and often by first intention and (3) there is the least chance of surgical shock. The prevention of surgical shock is a large factor in decreasing the mortality in this type of surgery. By this method (4) the amputated stump can be completely healed and the patient out of bed in a few weeks. This is of the utmost importance in dealing with patients who have

far advanced arteriosclerosis and associated visceral complications diabetes nephritis high blood pressure and myocarditis

PRE-OPERATIVE TREATMENT

By pre-operative treatment is meant the preparation of the patient for the operation. The diabetic condition should be controlled so that the patient can be operated upon with the least possible risk. No general plan can be outlined since every case requires individual consideration. Diabetic gangrene is a disease of middle and later life due more to arteriosclerosis than to diabetes. The latter is very often detected accidentally after the gangrene has existed for some time and frequently after it has proved resistant to ordinary therapeutic measures. It so happens that diabetes is often overlooked until gangrene has progressed to a dangerous stage. The examination of the urine and blood for sugar should occupy a more important position in the routine care of cases of gangrene. In this series of cases with exceptions all patients were within the ages of 53 and 67 years. They all showed an advanced arteriosclerosis especially the excepted younger ones (Cases 3 and 10). The blood pressure was either normal or only slightly above normal. The heart was in good condition (with the exception of Case 1 which showed auricular fibrillation).

The pre-operative treatment therefore depends upon the condition in which the patient is first seen. When there is enough time for pre-operative treatment there is no difficulty in bringing the blood sugar under control. A diet low in calories (about 1000) with liberal amounts of carbohydrate (100 to 150 grams daily) together with small doses of insulin (10 units or 5 times a day) is usually sufficient to reduce the blood sugar to normal and clear the blood of acetone unless the diabetes is unusually severe or systemic intoxication has begun.

A different situation arises when the operation is to be performed immediately. When the blood count shows progressive leucocytosis the temperature is rising and lymphangitis is developing the patient's general condition makes an operation imperative. In these cases we simply try to suppress acidosis by giving insulin and liberal amounts of glucose intravenously. Not enough stress can be laid upon the fact that in elderly diabetics who have never been under dietary or insulin management the insulin requirement is generally small. The initial pre-operative dose seldom needs to be over 5 units and an equal amount of glucose intravenously (in

grams) should be given simultaneously. If the blood sugar is maintained between 80 and 150 milligrams per 100 cubic centimeters and the blood free of acetone the patient is considered safe for operation.

The use of cardiac stimulants depends entirely on the behavior of the heart and blood pressure. Among these stimulants intravenous glucose ranks first in importance and is found to be most rapidly effective. Second in importance is caffeine sodium benzoate administered hypodermically. The numerous preparations of digitalis are useful when given for some time prior to operation but would not suffice in an emergency unless given in large doses intravenously. In case of an acute collapse it may be necessary to administer adrenalin.

In this series ordinary nitrous oxide oxygen anesthesia has been employed. At times in order to obtain complete relaxation it is necessary to use ether. Deep anesthesia with nitrous oxide alone might develop signs of circulatory failure. In general this method has been entirely satisfactory. If a general anesthetic is regarded as an excessive risk it is certainly more conservative to use spinal anesthesia as this involves less shock. In the present series however this method was employed but once. In that case the spinal anesthesia was not sufficient and had to be supplemented by gas oxygen. It is therefore not possible to express an opinion based on actual experience with spinal anesthesia. We have found the gas oxygen anesthesia rapid effective and without detrimental effect on the diabetic condition.

OPERATIVE TECHNIQUE

Three main types of operation have been employed: (1) the Stephen Smith amputation below the knee; (2) the Stokes Gritti amputation above the condyles of the femur; and (3) amputation in the upper middle or lower third of the thigh.

The first type of operation has been performed in the classical way. A sufficiently large amount of fibril below the tuberosity was excised obliquely in order to prevent pressure necrosis. In spite of this precaution secondary gangrene has been observed. Even with perfect healing the stump has not proved satisfactory for weight bearing. Therefore the second type of amputation is preferred whenever the third type can be avoided.

The second type of operation the Stokes Gritti has been most satisfactory both as to healing and as to the giving of a good weight bearing stump. This operation has been performed even in preference to the Stephen Smith

whenever the dorsalis pedis and popliteal pulsations were palpable and a sufficient blood supply was certain. This is the operation of choice in cases in which the surgical risk is not great and the patient's condition is satisfactory for prolonged anesthesia. When the operation is to be quickly performed it involves less risk to the patient beyond 50 years of age to have a mid thigh amputation. This consideration also applies to cases in which the circulation in the popliteal vessels is poor when the infection has been spreading rapidly or when the general condition of the patient is extremely poor. In these cases amputations are done above the knee with a circular incision. No tourniquet should be used in amputation upon the diabetic. The incision must be precisely made with a sharp knife and as little trauma as possible produced. Hemostasis should be complete only the individual vessels being caught and tied with plain catgut. Vessels or muscle tissue should not be ligated *en masse*. Hemorrhage from muscles can be controlled with single sutures tied just tight enough to prevent oozing. High as the amputation is performed a certain amount of superficial necrosis may result and it is consequently advisable to amputate with certain rapid and deft incisions. When mattress sutures are employed to control muscle bleeding it is noted that superficial necroses of the stump are favored. The wounds are closed without drainage. Black silk is used to close skin flaps since this has been found to be less irritating than silkworm gut or some other non absorbable suture.

After the third day inspection of the stump should be made daily and where there is slight crepitation or saprophytic odor one or two sutures should be removed and drainage promptly established. The wound is held open with gauze saturated with Dakin's solution. A heavy wool stocking is applied to the other limb to prevent pressure necrosis while the patient is confined to bed. A Balkan frame with a longitudinal bar should be used over the bed and the patient encouraged to exercise as much as possible. Deep muscle massage by the Swedish method should be employed daily.

On account of the poor condition of most of these patients the third type of amputation has been given preference where the Stokes Gritti operation might have been performed. The results have been excellent and in many cases first intention healing has been observed. Nevertheless preference should be given to the Stokes Gritti operation whenever the condition of the patient is favorable for a prolonged anesthesia.

POSTOPERATIVE TREATMENT

After the diabetic patient leaves the operating room he is to be regarded and treated as a patient in acidosis or diabetic coma. The anesthesia brings on or increases the tendency to acidosis and therefore measures must be taken to combat this condition. It is best to give equal amounts of glucose (grams) intravenously and insulin (units) subcutaneously immediately after operation. Forty cubic centimeters of 50 per cent glucose and 10 units of insulin usually are sufficient. If the operation lasts unusually long and if a considerable dehydration takes place physiological saline solution (about 1000 cubic centimeters) is given hypodermically. Postoperative vomiting occurs very rarely. It has been found that the intravenous administration of glucose seems to diminish nausea and prevent vomiting.

Four hours after the operation a blood sample is drawn and analyzed for sugar, acetone and alkali reserve. If acetone is present the blood sugar and the amount of acetone found govern the further treatment. When there is a considerable amount of acetone present and when surgical shock is extreme glucose and insulin administration is repeated in the same amounts as mentioned. Usually smaller doses of both are given as the majority of these patients suffer from an extremely mild but badly neglected diabetes. It is not desirable to have patients experience hypoglycemia or violent insulin reactions after operation because such conditions may bring on or increase restlessness and lead to embolism.

Another difficulty is that the beginning of low blood sugar reactions cannot be diagnosed with certainty during the first hours following operation as the patient perspires very freely and abundantly from circulatory causes. Only a blood analysis can give the exact diagnosis in such instances.

Four hours after operation most patients are able to tolerate fluids given by mouth in small quantities. This facilitates administration of carbohydrate in the form of fruit juices of various kinds such as orange juice, sweet cider, grape juice, ginger ale or sweetened tea. Any of these are easily tolerated if given ice cold. If larger quantities of carbohydrate are to be given iced tea with glucose or orange juice with sugar may be substituted. Should nausea prove too obstinate one dose of atropine sulphate (0.05 gram) hypodermically is of great benefit. If the patient is made adequately intravenous administration of glucose must be continued.

It is hardly possible to suggest a regular schedule for the further dietetic and insulin management. The examination for sugar and acetone of every urine specimen voided may help to some extent to facilitate further directions provided the renal threshold for glycosuria is not too high.

However during the first 4 hours both carbohydrate and insulin may be given at about 4 hour intervals. Thereafter a most careful diet with from 10 to 150 grams of carbohydrate plus a small amount of protein and practically no fat may be started. Such a diet is divided into 4 equal nourishments given at 8 a.m., 1 noon, 4 p.m., and 8 p.m. and insulin given with each nourishment. In order to shorten the night interval an additional midnight dose of insulin of 10 or 15 units and an equal amount of carbohydrate in grams is given. If the general condition of the patient allows the diet is changed on the third day to 700 or 800 calories of which 10 grams are protein, 10 grams are carbohydrate and 155 or 160 grams are fat. Very little or no salt is given in order to facilitate circulation and prevent undesirable edema or congestion.

One of our cases proved most refractory to any peroral intake of fluids. As this condition lasted for several days rectal administration of carbohydrate was substituted for some of the intravenous injections. The patient easily retained 15 grams of glucose in 50 cubic centimeters of water by enema.

When the administration of cardiac stimulants is necessary caffeine is preferred to digitalis. Its effect is immediate and unlike digitalis it causes no gastric disturbances or other deleterious effects. In case of shock during or after the operation adrenalin may be given in addition to caffeine in order to combat vasomotor paralysis. As soon as the patient is able to drink freely strong coffee may be given.

In selecting special nurses for diabetic surgical cases thorough knowledge and familiarity with insulin treatment should be demanded. Operations should be performed in hospitals which offer all facilities for blood chemistry. The internist must be responsible for the pre-operative and postoperative diabetic treatment. Concerning the selection of site and technique of operation the surgeon, especially if inexperienced with surgery on diabetics, should give preference to the more radical amputation in the mid thigh. Best results are obtained when the surgeon and internist observe the rights and requirements of their mutual provinces.

DISCUSSION OF SERIES OF CASES

Our series is comprised of 13 cases of gangrene requiring amputation. In Table I the sex, age, blood pressure, infected area, site of operation and results are given.

Sex. Of the 13 diabetics on whom amputation was performed 8 or 61.5 per cent, were females and 5 or 38.5 per cent were males. This preponderance of females over males is rather surprising and is in contradiction to the statistics of Joslin and of Eliason and Wright. Among 84 cases in Joslin's series 58 or 69 per cent were males and 26 or 31 per cent were females. In the series reported by Eliason and Wright 60 per cent were males, 40 per cent females.

This increased incidence of gangrene in females in this series although small was probably due to the fact that the majority had badly deformed and neglected feet resulting from ill fitting shoes, corns and callosities often improperly treated by chiropodists. These women were obese and unaccustomed to exercise and had poor circulation as the result of the advanced arteriosclerosis. This condition together with the uncontrolled hyperglycemia prevented healing and favored gangrene.

Among the male patients none was obese and the gangrene was more the type produced by arteriosclerosis. Excruciating pain in the affected part was the first and only symptom complained of and occurred weeks or even months before the onset of the gangrene.

Age. The youngest patient was 4 years of age, the oldest 67. The average age for the series was 58 years. Both the youngest and the oldest patients were females, their average age being 55.6 years. The male age averaged 60 years, the youngest being 55 and the oldest 66. This coincides with the statement of Eliason and Wright regarding the average age of their patients.

Vascular system. The arteries showed definite signs of advanced sclerosis, especially in the youngest patient of our series who had a most severe sclerosis of the femoral and popliteal arteries. For this reason it was necessary to resort to the higher type of amputation although an amputation below the knee had been primarily intended. It seems that the ischæmia due to advanced arteriosclerosis is the most important factor in the development of gangrene.

Diabetes especially when uncontrolled increases the tendency toward and aggravates the already existing arteriosclerosis.

All of these cases were of this type. In 2 cases the diabetic condition was undiagnosed prior to admission.

TABLE I—SUMMARY OF FINDINGS IN OUR THIRTY-N CASES

N m t	N	A	C	D	Bl I Pr	I f d	S	R I	
	M B M			6	5	d f	M f h h	H l l by f y	
	M F I		7		84	ught t	M l h h	H l d b p m y	
	M F J					L f f o	H l k	H l l by l m y	
	M I			7	N m l	R h h l	M l h h	H l l b p m	
	M J J			7	N m l	I f	M l h h	H l l b p m y	
	M F M N	5			N m l	M d l l l l	B l k	H l l b l	
7	M W Y			6	7	N m l	g h f f	B l k J l f h R l	
	M A K			8	0-	58	g	M l h h	H l l b p m y
	M C M				0	8	h h	R h k	H l l b l y
	M A H			0-	0-		I l	L f k	H l l b p y
	M H J	5			9	L l l	M l h h	H l l y p m y	
	M P C				0-	L f f	B l k	S p m D h	
	M C K			8	N l	R h l	M l h h	H l l by l	

TABLE II—ADDITIONAL CASES (SINCE SUBMISSION OF I AM R)

N t	N m	A	I	P Bl I	I f d	S	R I		
	M A I	1		5	8	7	R h l	M l h h	H l l b p m y
	M I	68		7-			R h l	M l h h	H l d b l y
	I	65	8	8	4		L f u	M l h h	H l l b p m y
	M I J	6					R h l	M l h h	H l l y l y
	M I			8			L f h l	C a t h d t m	J p f h l
	I I L	7		0-5	N m l		R h m l l k	E l m l	N e h l l o m h f l

Bl I pre sure. We believe that the sclerosis of the larger arteries with resultant thrombosis is more responsible for the development of gangrene than are the sclerotic changes in the arterioles. This is borne out by blood pressure studies. The blood pressure in the majority of these cases was normal. 8 of the 13 patients or 61.5 per cent having a normal blood pressure. The presence of arterio sclerosis did not appear to affect the prognosis or influence healing. In one of the fatal cases the condition of the heart was most unfavorable. Atrial fibrillation existed at the time of operation and this was confirmed by the electrocardiogram. Death was due to septicemia.

A full. The choice of the more radical type of amputation has proved very successful. Of 11 patients only 1 died making a low mortality of 9.1 per cent. This compares favorably with the result reported by Linton and Wright whose mortality in diabetic gangrene was 33.1 per cent and with J. Lin's mortality of 10 per cent. In our series however the mortality would prob-

ably have been even less had a more radical amputation been employed in the fatal case. Both patients were subjected to a conservative amputation below the knee. This low mortality is noteworthy as most of the cases were admitted with advanced gangrene and septicemia.

Infected area and prognosis. The extent of the infected area bears little significance to the prognosis if the operation is of a radical type. Even when the whole foot is involved as in Case 11 complete recovery with primary union is obtained.

Healing of wounds. Of 21 cases with complete recovery 8 (38 per cent) healed primarily.

SUMMARY

The object of this report and the conclusions drawn from a careful study of the results are that to be successful the most radical treatment may prove to be the most conservative. In view of the high mortality involved it cannot be considered a conservative procedure. The amputa-

and reamputate gangrenous extremities. It is more conservative to subject the patient primarily to a more radical amputation if life can thereby be spared. This series of cases is small but carefully studied and when considered simultaneously with other reports on the same subject the conclusions are essentially the same.

CONCLUSIONS

1. All diabetic patients with gangrene of an extremity show advanced arteriosclerosis.

Patients with dry gangrene which is not too far advanced often recover entirely by adequate medical treatment and do not require surgical intervention.

3. Diabetic gangrene is frequently precipitated by thrombosis in vessels the caliber of which is already restricted by advanced arterial disease. This is favored by irritation from pressure heat or cold, corns and calluses.

4. The operative indications are (1) the presence of signs of a rapidly spreading process, (2) the presence of a violent infection with signs of septicemia or severe toxemia, (3) the presence of a diabetic condition which can no longer be controlled by means of frequently repeated and increasing insulin dosage with proper dietary treatment.

5. Amputations for diabetic gangrene are to be considered as emergency life saving procedures to be carried out in the most expeditious and efficient manner possible.

6. The most radical amputation yields the best results.

7. The Stokes Gritti amputation should be given preference when conditions permit.

8. The preoperative treatment must establish control of diabetes and combat acidosis. Cardiac stimulants may be used if indicated.

9. Postoperatively the patient should be considered as a case in acidosis or diabetic coma and proper measures should be instituted to combat this condition. During convalescence the aim is to restore the patient gradually to a normal diet.

NOTE.—Since this paper was submitted for publication 6 additional cases have been operated on 5 with gangrene of parts of lower extremities and 1 with an advanced gangrene of the left hand following a paronychia. In employing radical methods of amputation in 5 of these cases we were able to obtain results equally as good as given in the foregoing part. The sixth case (No. 19) a gangrene of the right middle toe was given a chance for a more conservative treatment. Only the toe and part of the metacarpal bone were removed. The result was by far inferior to those obtained with radical operations and the foot is still in condition of healing 6 months after the operation.

In adding these additional 6 cases to the original series the mortality is reduced to 10.5 per cent (from

14 per cent). When considering that this improved rate is in statistics 46 per cent larger than the original mortality to include the postscriptum.

The therapeutic figure does not reveal any change through the additional cases. The average age for the male patient is 56.1 for the female 56.6 and the total average for the series remains unchanged at 58 years. The proportion of males is normal in 66.6 per cent of the total cases (as compared with 61.5 per cent before). The proportion of females over males remains entirely unchanged in the female series, 61.5 per cent of the entire series.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

IRVING H. MERTZ, M.D.
ALL B. KAUFMAN, M.D.

Managing Editor
Associate Editor

WILLIAM J. MCGLOTHLIN, M.D.

Chief of Editor for Obstetrics

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OLD CONGENITAL DISLOCATION OF THE HIP

THE surgeon is frequently confronted with the problem of deciding on the merits of the open operation for unreduced congenital dislocation of the hip. His opinion will be influenced by the age of the patient and the history. For many of the patients have received treatment in childhood and suffered prolonged fixation in plaster of Paris casts. As a result of such maldevelopment as a poorly developed acetabulum, head or neck of the femur and hour glass capsule or because perfect reduction had not been brought about or fixation has not been maintained long enough the disability persists. In most of such instances further forceful manipulation would result in more harm than good. It must be remembered that some of these unsatisfactory results are due to lack of co-operation on the part of the parents. In other cases when patients are unable to remain long enough in hospital excessive soiling may result in complications which necessitate the abandonment of treatment for a time. In many instances repeated

manipulations have failed and surgical intervention is the only hope. In others open operation for reduction has failed and deformity, pain and disability increase in severity.

Careful physical examination usually discloses shortening and upward displacement of the trochanter, as well as a decided limp. Manipulation or weight bearing may or may not cause pain on the affected side. When the patient stands upon the dislocated limb the pelvis tilts downward on that side. If the dislocation is bilateral the gait resembles a waddle. The diagnosis is verified by means of roentgenograms. Careful study reveals the condition of the acetabulum, head and neck, evidence of possible injury from previous manipulations, evidence of a new acetabulum and so forth. In young patients bone development may be delayed on the affected side as is demonstrated by slower osseous union between the ischium and os pubis and delayed growth of the centers of ossification. In older patients considerable variety of deformity exists: the acetabulum may appear shallow or practically gone, that is filled in, and a new one may have formed above the natural site. If the head and neck appear normal and a good acetabulum has formed nothing is to be gained by operation and the patient usually does well if left alone. Most of the patients come after childhood for relief of pain and increasing limp and deformity which indicate upward slipping of the head on a smooth ilium. In some cases the head and neck are almost destroyed and the surgeon must decide which type of surgical procedure is most likely to afford some

permanent stability relieve pain and preserve motion

In the younger patients it is sometimes possible by extension or by preliminary manipulation to improve the position of the head and by open operation and enlarging the acetabulum if necessary to bring about reduction. When the acetabulum is shallow and the tendency to dislocation is quite marked stability is improved by turning down bone from the ilium so as to make a ledge directly above the reduced head. When the patient has passed beyond the period when reduction of the head is possible one may resort to the so called bifurcation operation in which oblique osteotomy of the femur is performed opposite the acetabulum and the lower fragment of bone (which consists of the pointed upper extremity of the shaft) is thrust outward and inward against the capsule and the limb put up in moderate abduction in a plaster of Paris cast. This insures a certain amount of stability and security and at the same time allows a limited amount of motion. The possibility of performing a reconstruction operation after excision of the head of the femur must also be taken into consideration as in a certain number of these cases the acetabulum is good enough to hold the neck of the femur and afford stability with mobility.

In older patients when reduction is impossible and a new acetabulum has not formed so that the upward displacement of the head of the femur with each step causes pain limp and partial disability some other means of affording stability must be devised. This is usually done by means of open operation and the creating of a bony ledge from the ilium (or elsewhere) above the head and capsule to provide stability. By moderate abduction and fixation splendid stability may be afforded by this method the limp may be improved and pain alleviated.

Thus the surgeon must discriminate between various procedures if he is to alleviate what is commonly considered a rather hopeless affliction.

HENRY W MEYERDING

SHALL SURGEONS TELL THE TRUTH?

AMONG the many puzzling problems that surgeons often face is what to tell the patient. This apparently simple problem looms large. It is particularly prominent in cases of cancer. The confusion of the public as to whether a doctor will tell the truth about a case is often made worse by the divergent views of the members of the medical profession. Thus a prominent neurologist of New York in an article in *Harper's Magazine* a few months ago entitled "Shall Doctors Tell the Truth?" maintained the thesis that there were many instances in which doctors should deliberately deceive their patients. On the other hand Dr Richard C Cabot many years ago conducted an investigation as to the wisdom of accurately informing patients about their diseases and concluded that solely from a clinical viewpoint patients who were told the facts seemed to do better than those who were deceived. This work of Cabot however is but little known and an unfortunate situation seems to have arisen in which according to public opinion surgeons and physicians find it necessary to have a special lying license in order to carry on their work.

In cancer this problem often arises. A patient with a suspicious lump in her breast will be accompanied by a daughter who in a private interview requests the surgeon not to tell her mother that the mother has cancer because the daughter is certain that the patient will be greatly affected if she knows the

diagnosis. If such a policy of deception is deliberately pursued the patient sooner or later will doubtless know the facts particularly if there is a recurrence. There can be no real co-operation in the operation and the after-treatment and even worse still the daughter will unconsciously lose respect for the surgeon and for his veracity. If the daughter in the future has a lump in her breast and goes to the same surgeon and he tells her that it is a benign growth she may be too polite to say so but she will think. The surgeon deceived my mother how am I to know whether he is telling me the truth. Thus an increasing distrust of surgeons and of the medical profession generally is bred while we sorely need public confidence in order to carry on research work to diminish cancer and heart disease and to wipe out contagious infection.

How can we expect an intelligent public to co-operate wholeheartedly with a profession that deliberately lies to the patient. Surely it is unnecessary to pour brutal truths in the patient's ear and if the patient's relatives or friend request that a disagreeable diagnosis be withheld the surgeon should respect such a request. The surgeon too should put as

optimistic an outlook on any clinical study as the facts will justify. But all this is quite different from deliberately adopting the policy of telling the patient that he or she has no malignant disease when the surgeon is positive that the patient has cancer.

The very basis of scientific work is a search for truth and surgeons in the operating room and in the laboratory cannot consistently pursue the search for truth while in their private practice they are suppressing it. Such a policy is not only inconsistent and generally demoralizing but is to a large extent responsible for much of the distrust of physicians and surgeons that is now only too prevalent. Usually the surgeon can explain to an intelligent patient the general outlines of the diagnosis and treatment to be followed and if the results are not entirely as expected a frank disclosure of the reasons should be acceptable to any intelligent layman. We owe it not only to the public but to ourselves to adopt some policy of informing the patient—a policy which will be worthy of the fullest confidence of the public and which at the same time cannot tend to weaken our own regard for truth.

J. SHELTON HORSLEY



RICHARD H. HAPTE
1855-19 5

MASTER SURGEONS OF AMERICA

RICHARD HICKMAN HART

RICHARD HICKMAN HART was born in Rock Island Illinois October 3 1855. He passed his entire professional life in Philadelphia and died November 14 1935 at Vicksburg Mississippi.

Dr. Hart was graduated from the Medical Department of the University of Pennsylvania in 1878 and received his early training in surgery in the University Hospital as assistant to Agnew and to Ashhurst and later in the Pennsylvania Hospital where he became a surgical chief in 1895. He also served as surgeon to the Episcopal Hospital (1889-1904) to St. Mary's Hospital (1893-1899) and to the Orthopedic Hospital (1904-1914).

Possessed of an ample fortune Dr. Hart may be said to have practiced his profession as Johann Sebastian Bach wrote music for the glory of God and for a pleasant occupation. He never had a very large private practice but delighted in his work in the hospital wards paying particular attention to the old the helpless and the miserable especially to those unfortunate whose sojourn is long in the dreary dwellings which border on the shades of death. Though never of very robust physique himself he radiated an atmosphere of cheerfulness and hope among his patients and they cherished his visits and appreciated his neatness and gentleness in dressing their wounds more than his operative skill of which they knew nothing.

Between the ages of 50 and 60 years Dr. Hart gradually withdrew from practice and resigned one after another all of his hospital appointments except that of surgeon to the Pennsylvania Hospital.

Elected a Fellow of the American Surgical Association in 1895 he soon became an active and interested member rarely missing the annual meetings and contributing a number of valuable papers to its *Transactions*. From 1900 to 1909 he served as recorder until his election as president of the association in 1910.

Of Dr. Hart's war service it is impossible to speak adequately. Feeling very strongly the call of duty to assist the Allies he left his home and his many engagements in this country early in 1916 and served for many months in the American Hospital at Neuilly sur Seine (Paris). Returning to Philadelphia in

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the autumn of 1916 and foreseeing the entrance of the United States into the conflict he set about organizing two base hospital units one in connection with the Pennsylvania Hospital which became Base Hospital No 10 AEF the other in connection with the Episcopal Hospital which became Base Hospital No 34 AEF As director of Base Hospital No 10 he left for France in the spring of 1917 and remained on active duty in France until after the armistice During his absence he had the greatest sorrow of his life the death of his wife but he sought to forget his grief in constant activity saying that he knew it would be her wish for him to complete the task he had undertaken and he never faltered He was rapidly promoted to the rank of colonel and illness alone prevented him on his return to this country in the winter of 1918 from serving as chief surgeon of the Walter Reed General Hospital Washington D C

He received from General Pershing a citation for "exceptionally meritorious and conspicuous service" His work with the British Army was of such importance that it was mentioned in dispatches by General Haig and later Dr Harte was made a companion in the British Order of St Michael and St George The King of the Belgians decorated him as companion in the Order of Leopold and he was made honorary fellow of the Royal College of Surgeons of Ireland for conspicuous service rendered to the British Expeditionary Forces From our own country he received the Distinguished Service Medal

Dr Harte wrote very little He took special interest in the surgical complications of typhoid fever and published a number of important papers on perforation of and hemorrhage from the intestines during that disease He had probably the largest personal experience of such complications of any surgeon in the world

Dr Harte had a rare intuition of diagnosis and prognosis a surgical judgment which was almost infallible and operated with an ease and deftness which I have never seen equaled either in this country or abroad Every scalpel that he used seemed sharp tissues fell asunder as if by magic and with nearly complete absence of bleeding ligatures dropped from his fingers as if already tied and wounds healed with the most surprising rapidity and with the minimum of scarring It was with the deepest regret that his assistants saw him abandon his career as operating surgeon so comparatively early in life He resumed it only for a short time in France during the War and was delighted that the first patient on whom he operated at the front a soldier with multiple gunshot perforations of the bowel made an excellent recovery

He was as I have said never robust Subject to bronchial inflammations he rarely passed a winter without being in bed for a few days on one or more occasions He also suffered a good deal from a stiff and painful shoulder due to what he called neuritis which made him miserable sometime for weeks at a time When he was run down nothing would restore his health as soon

as a river trip or coasting expedition either in his own yacht or in that of his bosom friend Dr William J Mayo

Leaving Philadelphia with a bad cold and with his arm in a sling on November 1925 he joined Dr Mayo on his boat on the Mississippi River two days later at Memphis had a severe chill and took to his bed at once As soon as the presence of pneumonia was suspected he was transferred to the hospital at Vicksburg and there on the shores of his favorite river after a brave fight against the disease for more than a week attended by Dr Mayo and other friends and with his children beside him his spirit passed on to the other shore of the river of death He had lived his life with a conscience void of offense toward God and toward man

ASTLEY P C ASHHURST

MIRIAM BROWN MD FACS OMDA NREAS

BY RICHARD WISFMAN

Whether he has done as much as he did during the period of civil war and turmoil. What a man accomplished a great deal for his profession. Whether by his own ability.

I am a Practitioner not in Academick that I felt in those things as far as they are useful to life but thought it too great a digression from my present purpose to stuff up a practical Book with such a Philosophicall Curiosity which become it just as well as it would have become a Divine to fill a practical Discourse with School divinity. Some Historians have however found fault with Wieman for his neglect of the new thing in surgery particularly in his operation of amputation in which he clung to the old technique of Brunschwig and von Gerstorf rather than adopting the nature of Larrey. This was not as he explains because he did not know and appreciate Larrey's technique but because he believed that his operation required too much light and too many assistants for practical work either at sea where this work is done below decks or in the heat of battle where facilities for careful work are poor and dressing stations often and rapidly moved. Wieman gives an account of these difficulties in his work on amputation. He tells of an Irishman whose arm he had amputated and who believed the tourniquet had been left in place but he showed him it was not. Then he goes on to say "Two days after our men were called out of the town and Chappell fort I was at the same time dressing the wounded man in the Town and I ordered the Chappell fort and hearing a woman cry "Fly to the Fort" taken I turned as I usually am amazed to find the Line not knowing that had been done but getting up the Works I saw our people running away and those of the Fort shouting at them "I suspect do this Work to the Dutch a I got out of the Trench and as I began to run I heard a French Surgeon I turned back and I saw a German lay down a stunned Arm I thought it as the Irishman whom I had so lately remembered he upon whom I returned and helped him up. We ran together being within half a Minute hot of the French I returned but he ran me quite a naive exposure of the proof of the efficacy of his surgical treatment.

SEVERALL
CHIRURGICALL
TREATISES.

By *RICHARD WISEMAN*,
Serjeant Chirurgion.

L O N D O N,

Printed by *E Fleisher* and *J Macock*, for *R. Royston*
Bookseller to His Most Sacred Majesty, and *B Took* at the
Ship in *St Pauls Church-yard*, *Ann Dni. 1676.*

REVIEWS OF NEW BOOKS

LAMBLING¹ says that villous tumors of the rectum occur frequently and differ from other tumors of the rectum particularly from the adenoma and cancer in clinical aspect and histological characteristics. They occur almost exclusively in adults and elderly persons.

As to the symptomatology the author found that hemorrhages are present in three fourths of the cases which came under his observation. The most important and most characteristic symptom however is the discharge of a glairy mucus but this must not be mistaken for the mucopurulent discharge which we find in cases of cancer and old chronic proctitis. Whenever the tumor has assumed a fairly large size there may be a modification of the stools or a prolapse. Occasionally there is discharge of fragments of the tumor mass which is of course a symptom of great value. The author found that these tumors occur mostly at a depth of 6 to 12 centimeters and are therefore usually within reach of the examining index finger.

From an anatomical and clinical standpoint these tumors are divided into two classes: (1) benign villous tumors which during the course of their evolution may undergo a cancerous degeneration; (2) dentate villous tumors which are malignant from the start. These greatly resemble the villous tumors of the bladder. In benign villous tumors villosity is the essential distinguishing feature. The stroma is like that of the adenoma found in the rectum and may be pedunculated or sessile. From its surface ramifications may go out in complex formations. The epithelial layer which rests directly upon the stroma is made up of cylindrical cells and does not differ from the epithelial layer found in the intestine. Sometimes adenomatous reactions may be noted but must not be considered as essential as villous neoplasms may exist without any glandular proliferation whatsoever.

In his series of 37 cases Lambing found that 15 were actually undergoing a process of cancerous degeneration. The nucleus of the cell had become less oval and had left its position near the base for a more central location. The cells had become irregular and vacuolated; the protoplasmic elements had lost their affinity for stains and mitoses were more often present. Furthermore, the mucous producing function had disappeared.

The dentate type comprises a very clear and distinct type of villous tumor of the rectum. It shows no adenomatous or pseudoglandular reaction. The cells which make up its surface covering are typical malignant cylindrical cells similar to those seen in glandular epithelioma. The villous architecture and superficial development of this tumor however dis-

tinguish it very clearly from the glandular epithelioma. These cancerous forms remain localized for a long time and infect the lymphatics only at the last stages.

The clinical symptoms seem very often of an unimportant nature. Bleeding and pain are not often present and the general health of the patient is not affected. In making a diagnosis digital and proctoscopic examinations are of the greatest importance as it is only by these means that we are able to determine the characteristic formations of these tumors.

The evolution of villous tumors is slow sometimes taking years but one must always remember that cancerous degeneration may take place without the manifestation of any symptoms of the change.

The prognosis is based largely upon the therapeutic measures which are employed. The author is of the opinion that a surgical resection is the only way of dealing with these neoplasms. However even after resection these villous growths may like villous polyps of the bladder re-occur in other parts of the rectum.

The dentate malignant forms seem to have a better prognosis than does habitual cancer of the rectum. This is probably due to the fact that they remain localized for a long time and that metastasis occurs only in the very last stages. Radium therapy is of very little value. Fulguration may be employed in small tumors which are very accessible and well localized. Surgical removal is by far the best therapeutic measure.

C. J. DE BEEF

APERUSAL of the book on pulmonary tuberculosis by Stephani reveals it to be a work of great merit in which is admirably set forth the detail of the use of X rays in the treatment of this disease. In dedicating the book to his father the author indicates the basis on which the work was founded namely, the enormous experience in the clinic conducted by the elder Stephani.

From introduction to finish this book is replete with splendid presentations in word and picture of the various phases of X ray procedure and interpretative deduction. Like many European roentgenologists Stephani prefers the old gas X ray tube for chest exposures rather than the more convenient Coolidge tube so that this section of the book reads like subject matter of a decade or more ago. The chapters on the interpretation of roentgenograms are splendidly written and the illustrations deserve special commendation.

If this book were available in English it would undoubtedly be a valuable addition to the increasing bibliography on X ray subjects. E. S. BLAIR

Subjects of such practical importance as New Developments in the Treatment of Peptic Ulcer Dyspepsia The Treatment of Nervous Indigestion The Syndrome of Malignant Hypertension and others contrast with more scientific studies such as The Vascular Lesions of Portal Cirrhosis Effects of Obstruction of the Common Duct of the Liver and the description of a method of making an Eck fistula The otolaryngologist as well as the internist and surgeon will be interested in the paper by Rosenow on the pathogenesis of diseases of the eye and Lillie's work on sepsis of otitic origin A number of articles are concerned with the descriptions of technique for instance the removal of thyroglossal cysts and fistulae by Sistrunk and massive bone grafts in non union of the humerus by Henderson This range of subjects illustrates in only too inadequate a manner the tremendous amount of clinical material which has been studied and the well directed experimental work that has been done Probably in no other clinic is carefully checked experimental work brought so closely to the bedside of the patient with advantage not only to the patient but to the world at large

This annual volume which reports although not completely the scientific activities of the Mayo Clinic is indeed a fountain of information The present edition is indeed a welcome contribution to scientific medical literature JOHN A WOLFER

LAPORTE'S small concise monograph¹ on the anatomy technique extent indications and possible dangers of epidural anaesthesia is before me Epidural anaesthesia usually referred to as sacral in the United States is really one of the simplest and safest methods and one that has definitely decreased the mortality and morbidity of prostate and bladder surgery It is to be regretted that gynecologists are still so hesitant to make use of a simple nerve block that anaesthetizes both the anterior and posterior wall of the vagina and the cervix

The author's technique is well described simple and efficient He mentions no cases in which the anaesthesia did not extend high enough to anaesthetize the prostate completely This may probably be due to the strikingly large amounts of novocaine solution injected into the sacral canal where absorption is known to be quite rapid One might be in

clined to express a word of caution against the use of such large amounts The author's indications conform to the general usage The reviewer would only take exception to sacral anaesthesia in operations on haemorrhoids and anal fistulae as a perirectal infiltration is much simpler and produces a welcome anaemia

The illustrations are well selected The bibliography is somewhat biased GLZA DE TAKATS

THE first edition of *Die Erkrankungen der Blutdruesen*² appeared in 1913 and was translated into several languages The present edition brings the greatly increased literature on the glands of internal secretion up to date As usual in such volumes the references to the literature are quite complete and largely embrace the literature of the world The volume is written in a clear and easy style

The general discussion covers the history general physiology and pathology of the glands of internal secretion The second part of the volume contains a detailed description of the diseases of each gland In discussing the thyroid gland the author makes frequent reference to the work at the Mayo Clinic on thyroxin and the use of Lugol's solution in the pre operative treatment of hyperthyroidism After considering the various methods of treatment of hyperthyroidism including internal medication surgery and X ray the author says In all cases in which there is not a direct indication for operation (compression symptoms and adenomatous goiter) X ray therapy should be tried first

The discussion of tetany is complete except that Collip's separation of the parathyroid hormone is merely mentioned In the treatment of enlargements of the pituitary gland especially acromegaly X ray or radium treatment given prior to operation is considered Dystrophia adiposa congenitalis and diabetes insipidus are discussed as quite probably arising from lesions in the hypothalamic region as well as in the pituitary as shown by Phillip E Smith

Discussion throughout the text is full and various opinions are considered but the author's final conclusions are conservative To all who are interested in endocrinology this volume can be warmly recommended both for its subject matter and bibliography

DOUGLAS C. SUTTON

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AMERICAN COLLEGE OF SURGEONS

OURSELVES—THE COLLEGE¹

JOSEPH DAVID STEWART M.D. I.A.C.S. NEW YORK

THIS short talk will be in the nature of a sermon and the text will be ourselves. It will be addressed both to laymen and to the profession but particularly to the latter. It is inspired by the certain conviction that neither the profession nor the lay public is adequately familiar with the immense amount of altruistic work which has been done by the American College of Surgeons nor aware that this work has been done primarily for the benefit of the public—that from the materialistic point of view the doctor has derived little or no advantage—that the only good that has come to the doctor has come in the shape of a greater opportunity—an opportunity which by co-operation and by the stimulation of comparison enables him to realize the best that is in him, his finest ideal. It is based on the further and equally certain conviction that many of us—even our own members—are not entirely familiar with this work and bears the assurance that this familiarity could be obtained simply by reading the *Yearbook*—that familiarity with the *Yearbook* would lead to a finer spirit of understanding and co-operation that place this familiarity with the work of the College our members should become better teachers of the public, finer exponents of good health and efficient surgery. This is the only way the public can ever learn the broad simple truth of medicine, the only way in which they can learn that medicine is dynamic not a finished science, the only way in which they can learn the medicine of surgery, they really ought to know.

The public ought to be taught to realize that while doctors are helping to prevent and can assist in the cure of disease there are many problems yet unsolved by medical science, some illnesses that still baffles the highest medical skill. Only a vocation such as this can speak to the public with authority of the advances that have been made in medicine, can help the public to separate the real from the spurious, to disassociate error from truth.

Let us look at the aims and ideal which prompted the founding of this College, recount

briefly the means taken to realize these ideal, dwell for a short time on some of the activities of the College and see if there are not lessons for us and for the public, lessons which if properly learned may bring useful results. The ideal that animated the Founders were to elevate the standards of surgery, basing that standard on character as well as competency, to teach the public and the profession that the practice of surgery calls for special training, to make the public aware that Fellows of the American College of Surgeons possess this special training. This altruistic program concerns two groups—the public and the profession—but a moment's consideration will show that it is primarily and permanently in the interest of the public that the combined and ultimate aim is to lessen disease and suffering and to promote the happiness of the people. This program has not succeeded completely, but what finite program ever succeeded completely? It is human to be almost perfect, it would be superhuman to be altogether perfect. If this program has failed it is chiefly in direction that affect the material welfare of the doctor alone.

It is only 25 years since this College was founded by a group of 450 well known surgeons who met on the invitation of a committee which committee was appointed by the Clinical Congress of Surgeons and organization since merged with an ideal one of the activities of this College. Its organic growth has been interrupted but not retarded by the Great War. The fire through which the medical profession passed to Moloch has been a refining fire improving the temper and the balance and the spring of the metal of the profession to which we belong. The war leaving aside all the lessons of patriotism and devotion and courage, lessons far transcending any contained in the three K's, has taught and enlarged the lessons of co-operation, the value of organization and standardization in which each man finds the post to which he is best suited, in which his talents may be best employed. It is recognized that some men are seers who vision great things whose dreams sometimes come true, others are

repair men who find the break or leak and stop the damage before it has gone too far still others are seekers after truth research workers logical minds who bring new truths to join the magnificent collection that make up the science of medicine

Of the various activities organized and set in motion by the College in its brief existence it is only possible to mention a few these activities have been discussed by your officers and printed in your Yearbook One activity it is proposed to consider briefly in order to illustrate the far flung effect that the College has had on American medicine and surgery in all its ramifications to emphasize the benefits that the public have derived from the efforts and to point out the allegiance that is due to the College from medicine in general and from the Fellows in particular—I refer to Hospital Standardization This *magnum opus* was originally undertaken because the method of practical examinations prescribed for admission to the College demanded that the candidate submit fifty histories of operations performed by himself These histories had to be obtained from the hospitals and often because they had never been written or because of faulty filing they were not obtainable Thus the investigation of the making and filing of records led to a knowledge of all the other activities of the hospital the organization of the medical staff the management the personnel the interne staff nursing staff indeed every activity in which a hospital can be engaged every contact which a hospital can possibly make

Early in this investigation so much did the hospitals vary in their efficiency it became necessary to formulate a minimum standard a term with which you are more or less familiar although it is certain that every connotation of the term is not known to all This minimum standard is low enough God knows but it is one that has demanded for most hospitals improvement in one or more of their departments For the hospital which has already advanced beyond or wishes to go beyond it has no numbing effect on these it exercises no restraint This minimum standard provides that the medical staff shall be restricted to physicians and surgeons who are regularly qualified licensed practitioners of medicine competent in their respective fields worthy in character and ethical in practice not indulging in the burglarious division of fees It further demands that the staff must hold monthly meetings at which the work and results of each man are reviewed in open meeting that accurate and complete records be written and filed and

made always available that there be an adequate follow up system so that the final disposition of the case shall be known by which the value of the treatment may be tested that diagnostic and therapeutic facilities be made available by the hospital authorities including clinical and X-ray laboratories The Committee on the Registry of Bone Sarcoma says in one of its reports We have furnished a list of the clinical entities to which a bone tumor may belong if any one believes that there are other kinds of bone tumors than those mentioned he may register typical examples That is the broad liberal ground taken by the minimum standard if you can surpass the demands of the minimum standard by all means do so but only the workers you and I know how few hospitals there were before inspection that had attained the excellency of this standard how very many there were that had to improve in order to reach this standard

As already stated the greatest good that has come to the doctor out of these changes is the opportunity to do better work Surgeons may be divided into two great classes those who wish the chance to practice surgery and those who are seeking the opportunity to prepare themselves for the practice of surgery between these two is a great gulf fixed It is only fair to add that most men would be glad to practice scientifically and competently and ethically if the opportunity were given and if nature had not averted her face when intellectual and moral distributions were being made Hospital Standardization—the minimum standard—has given these opportunities has given to doctors better equipment By co operation and adjustment it has assigned them to the posts for which they are best fitted By the comparison it has afforded with their Fellows they are broadened their medical education is immensely increased to their great satisfaction and most important to the greater comfort and safety of the patients entrusted to their care There are few surgeons in this room who cannot look back to improvements in the hospitals in which they have worked following inspection by the American College of Surgeons and forward with confidence content that there will be a constant striving for further improvement

This movement puts the small hospital on a par with the great makes the small town as safe as the large turns a small practice into a vivid and wonderful experience The speaker recalls with the keenest pleasure a conference which he attended in a relatively small city the cases were well studied and well presented and no large city or university center could have surpassed the

excellence of the work. Compare this with the circumscription of view that bounds the isolated worker and the conclusions are inevitable.

One of the aims of the founders it will be recalled was to teach the public and the profession that the practice of surgery calls for special training and to make the public aware that the members of the College possessed this training. The hospitals themselves have furnished the best means of conveying this information. A large percentage of the public are aware that an approved hospital is a reliable hospital and that it is manned and officered by reliable medical men and this information is spreading very rapidly. Only recently there has come to notice the case of a hospital which has allowed itself to become standardized because the staff were unwilling to write histories. To the lay audience it may be explained that the history of the case is exceedingly important in making a diagnosis important in the further conduct of the case and also important in the diagnosis of similar cases under care. Later to be seen to the professional audience there is but one word for this dereliction on the part of the staff *incredible*. However in some ways it has come to the notice of the Chamber of Commerce and of the public in this town that its hospital supported by the citizens is not an improved hospital and at the present moment there is racing and chasing on Canobie Lea to reform and again to receive the approval of the American College of Surgeons. There may be a large percentage of the public who have not yet been told individually how to select a reliable surgeon but every one who owns an automobile may be looking in the book of the American Automobile Association to discover what hospitals are approved and if one is to have an accident he is hereby recommended to have it in a town where the hospitals carry the endorsement of the American College of Surgeons.

Of the surgical committees committees at work on subjects of broad surgical interest the Committee on Bone Sarcoma on Industrial Surgery on Traumatic Surgery it is impossible to speak. Each would demand more time than can be given

to the whole subject. Industrial surgery also involving the intricate relation between the employer the employed the insurance carrier and the public is almost as complicated and nearly as colossal as prohibition enforcement. There are many other activities of the College its building its publications its library its teaching films and moving pictures. Truly its library is in Chicago but by means of its package library its photostats and translations the library like every other good thing about the College will come to you. The College is indeed in the office of every Fellow. If you haven't made that use of the College you are not getting the full value of your fellowship.

It has been stated several times that this altruistic work is primarily in the interest of the patient. It should be explained that its cost has been borne by the medical profession. In one of the *Yearbooks* which it is hoped you will read it is cheerfully asserted that every year a certain number of Fellows die and that if the Fellows were willing to add to their wills a codicil saying

I bequeath \$1000.00 to the American College of Surgeons etc. there would be a substantial increment each year. No opposition to this plan is offered on the contrary it is heartily encouraged but an additional plan is hereby submitted for your consideration which is that being the teachers and confidants of the people a special providence to many of them you should confide to them what has been done in their behalf. If this statement should move them a small contribution from a very small percentage of your patients would furnish this institution with the means for furthering the great work and putting it on a permanent basis.

Already in its brief life history the College has set up a measure of efficiency for hospitals which has been accepted the world over. If every activity of the College except Hospital Standardization were suddenly suspended if the College were to go into financial and spiritual bankruptcy a work has been begun in the hospital throughout the land which must and will go on. The tempest here may be stilled—the wave it has created will break on other shores thousands of miles away.



Bon Dupuytren

SURGERY, GYNECOLOGY AND OBSTETRICS

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DUPUYTREN'S CONTRACTION

WITH A DESCRIPTION OF THE PALMAR PLEBIA A REVIEW OF THE LITERATURE
AND A REPORT OF TWENTY-NINE SURGICALLY TREATED CASES¹

ARTHUR B. KANAWILL, M.D., F.A.C.S., SUMNER I. KOCH, M.D., F.A.C.S., AND
MICHAEL I. MASON, M.D., Chicago

GUILLAUME BAKON DUPUYTREN, whom living all admired but whom few loved and no one understood, was born October 5, 1777 or 1778 (his biographers disagree as to the year) at Pierre Buffiere, a small town of Haute Vienne four leagues from Limoges. Napoleon and Wellington were eight years his senior. Beethoven seven. Turner two. Hokusai seven. Sir Astley Cooper nine.

In 1789 a cavalry officer stationed at Pierre Buffiere asked and received permission from Dupuytren's father, an advocate of limited means, to send the boy to school in Paris. There he studied for four years until the schools were closed in the turmoil associated with the Revolution and for lack of funds the young student was compelled to return the two hundred miles to his home on foot.

To fulfill his father's wishes and because the years at the College of La Marche had aroused his ambition, he determined to return to Paris and study medicine. His ambition was achieved but only at great self sacrifice. Often he was compelled to study in bed for lack of fuel for a fire. He used fat from cadavers to serve as oil for his light and at one time he lived for more than six weeks on bread

and cheese. It is said that but for the help of a friendly water carrier from Auvergne he would have starved during the earlier years of his medical education.

When scarcely 18 he was appointed professor in anatomy in one of the schools established by Fourcroy and from that time fortune smiled on him. In 1801 he was made head of his department with the title of Chef des Travaux Anatomiques. Among his pupils during this period were Laennec and Cruveilhier—names that have also attained enduring fame. In 1804 he competed against Roux, Tartra, and others for the position of surgeon of the second class at the Hotel Dieu and won the appointment. In 1808 he was again advanced and in 1812 after a brilliant *concours* in which Tartra, Roux, Marjolin, and Dupuytren were the contestants, he was appointed to the chair of operative medicine as successor to Sabatier. It is said by Malgaigne that his thesis on lithotomy submitted to fulfill one of the requirements of the *concours* was long regarded as a work of art and as a model of surgical and anatomical excellence which up to that time had not been equaled.

During the years preceding and immediately following this appointment an intense rivalry developed between Dupuytren and Pelletan

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the surgeon in chief of the Hotel Dieu. The former was a thorn in the flesh to his brilliant but indolent superior and to no opportunity of ridiculing the slipshod method and inaccurate diagnoses of Félletan before his students. Finally as a result of two unfortunate incidents Félletan was superseded by his younger rival.¹

Cruveilhier, one of Dupuytren's pupils, tells us of his methods and work at the Hotel Dieu. He arose daily at five o'clock and began the morning round at six and went to the house surgeon or nurse who was not on duty at the appointed time. The first task of the day was to make the rounds of the wards at which time he questioned and examined his patients with great care and thoroughness. To one of his house officers was assigned the sole duty of accurately recording the observations made on the occasions.

After the morning round he delivered a clinical lecture in the amphitheater of the hospital usually to classes of three and four hundred. Operations the out patient department and postmortem examinations took up the remainder of the morning. The afternoon was devoted to his consulting practice which became very large as his prestige and popularity increased. It is said that during the later years of his life his private patients numbered ten thousand a year. In the evening he

again made round at the hospital and frequently performed one or two operations at this time.

Needle to say he was compelled to pay the price of maintaining so strenuous a pace without thought of rest or relaxation year in and year out. One morning at the close of 1835 while on his way to the hospital he suffered a slight stroke of apoplexy. He went through his ordinary routine but on his return home was immediately bled. On recovering from this attack he made a tour of Italy—his first vacation but he was unhappy and restless anxious to resume his work. On his return he attempted to assume his regular activities but finally because of his increasing disability he was compelled to relinquish his place at the hospital. During the succeeding months he developed a chronic pleurisy which gradually led to a fatal termination February 8 1835.

Of Dupuytren's ability as a surgeon and teacher there can be little doubt. His biographers unite in considering him the first surgeon of his time and the founder of clinical surgery in France. No field of surgery that he touched but was enriched by his skill and ingenuity. He first demonstrated the nature of yellow elastic and erectile tissue he proved by animal experimentation that excision of the spleen could be performed with safety. He pointed out the fact that thromboses on the right side was frequently due to perforation of the vermiform appendix. He showed that chronic enlargement of the testis was often due to lues and could be cured by Dupuytren's pill. A mercuric preparation he introduced greatly improved method of treating fractures particularly fracture of the femoral neck and lower end of the humerus. He was the first to excise a carcinomatous cervix the first to describe congenital dislocation of the hip. He reformed the treatment of urethral stricture by introducing the method of gradual dilatation with flexible bougie. He was particularly interested in the treatment of lachrymal fistula and cataract. His treatment of the latter however by couching was not in accord with the best practice of his time and because of it he was bitterly criticized. Today his name is particularly associated with idi-

Observation made in a study of the palmar fascia both of the normal and of the contracted hand and to describe the surgical treatment employed for the relief of such contractions and the result of this treatment with case under our care.

THE PALMAR FASCIA

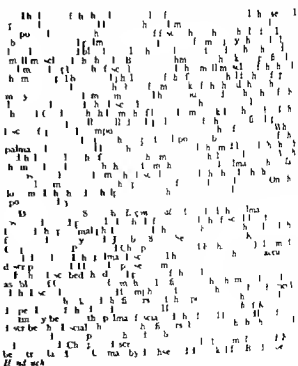
Commonly describe the palmar aponeurosis as a thick triangular membrane the apex of which joins the distal edge of the transverse carpal ligament and more superficially receive the insertion of the tendon of the palmaris longus muscle. The fascia separates below into four slips one for each finger connected by transverse fibers and forming beneath the webs of the fingers the superficial transverse metacarpal ligament (fasciculi transversi). Beyond this each slip separates into two parts to be connected to the sides of the metacarpophalangeal joint and the first phalanx of the medial four digit. The lateral borders of the triangular central portion of the palmar aponeurosis are continuous with thin layer of deep fascia which cover and envelop the muscles of the thenar and hypothenar eminence.

Spalteholz in the palmar aponeurosis lies in the palm directly under the skin and is intimately united with it by short fibers. It is triangular and consists of two layers. Its superficial longitudinal fibers are the expansion of the tendon of the palmaris longus and provide a diverging band chiefly to the skin of the finger at the level of the head of the metacarpal bone. The deep layer with its transverse fibers is the continuation of the fibers of the transverse carpal ligament. Near the free edge of the web of the fingers sharply demarcated band the fasciculi transversi which are in part united with one another proximally from the second to the fifth finger directly under the skin.

From the deep layer agittae septa which separate the canal like space for the flexor tendon and for the blood vessel and nerve from one another pass deeply to the metacarpal bone. They are united distally with the vaginal ligament. The thenar and hypothenar eminence are covered only with thin dermal skin.

The concise description of the palmar aponeurosis is leave unmentioned the remaining portion of the fascia of the hand of which the aponeurosis is only one though an important part. In reality the palmar aponeurosis is part of a complicated structure which forms a tubrous tissue investment for the entire hand and which is divided into superficial palmar deep palmar or volar interosseous distal and dorsal portions. Since the superficial palmar fascia is developed in such a striking fashion the remainder of the fascia of the hand has received little attention and many observers therefore have been puzzled to account for some of the phenomena found in Dupuytren's contraction since the contracting bands and cords often failed to correspond with the normal position of the palmar fascia.

In order therefore to obtain a more accurate and comprehensive conception of the fascia of the hand through the co-operation of the Department of Anatomy of the Northwestern University Medical School a careful study was made of a number of hands from the dissecting room and of sections of hand cut at different levels and in different planes. Every effort was made to correlate the information so obtained with the findings and



variations noted in contracted hands at operation. The following description of the fascia of the hand is based upon these studies.

For descriptive purposes the fascia of the hand may be divided into four parts: the superficial palmar fascia, the volar interosseous fascia, the dorsal fascia, and the digital fascia. Various septa, fibers, and ligaments help to unite the elements and bind them into a compact whole. Some of the elements of their prominence have received definite descriptive names; others have frequently been overlooked or at least unmentioned.

The superficial palmar fascia (Fig. 1) as noted above is accurately described in the palmar aponeurosis in most textbooks of anatomy. Its origin from the palmaris longus or in the absence of the latter from the antibrachial fascia, its triangular shape, its shiny, glistening appearance, its superficial longitudinal and deeper transverse fibers, its division

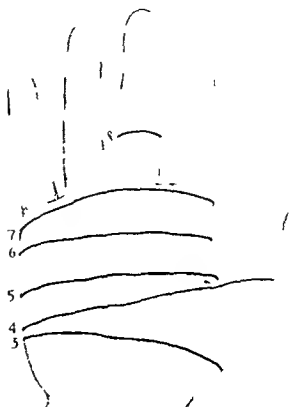


Fig. 1. Diagram indicating the division of the section illustrated in Figure 3, 8.

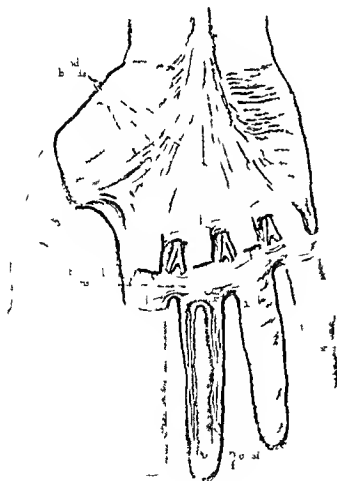
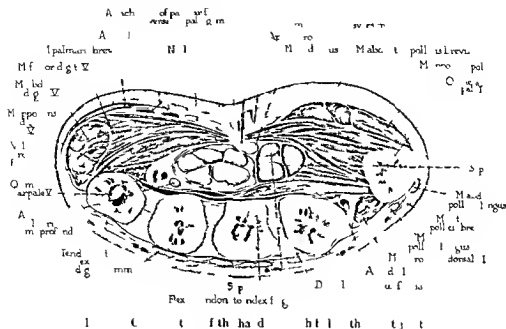


Fig. 1. The superficial palmar fascia (palmar aponeurosis).

into four distinct longitudinal bands (the pretendinous bands or *longuettes pretendineuses* of Poirier) inserted chiefly into the deep layers of the skin just proximal to the webs of the fingers, and a fifth less distinct band inserted into the skin of the first interosseous space (Fig. 1); its thinner lateral portions which cover the thenar and hypothenar eminences and the marked development of its transverse fibers at the webs of the fingers are well recognized features. Its intimate relation to the transverse carpal ligament (Fig. 3) and the many short vertical and oblique fibers arranged in fairly definite longitudinal lines which unite the fascia to the deeper layers of the skin (Figs. 3, 4) have been described by a number of observers, but are usually unmentioned in textbooks of anatomy. The latter are of particular interest for through this attachment between the palmar aponeurosis and the skin is produced the dimpling of the palmar skin which is frequently the first sign of Dupuytren's contraction. The thin fascial layer which covers the interdigital spaces and overlies the digital nerves and



ves. cl. 1 they become more superficial is the direct continuation of the central portion of the palmar aponeurosis but because of its tenuous character is usually unnoticed.

Of equal importance from a surgical standpoint with the superficial palmar fascia are the volar interosseous fascia, the digital fascia and the septa which unite them. The volar interosseous fascia (Figs 3, 4, 5) as its name indicates covers the hollow cup of the palm which is left after the removal of the flexor tendons, the digital nerves and the palmar arch. It is continuous with the fascia covering the pronator quadratus; it covers the palmar interossei and is attached to the carpal and metacarpal bones. At the head of the metacarpal bone its transverse fibers are strengthened and interdigitate with one another to form the transverse metacarpal ligament (*lig. capitulum transversum*) (Figs 6, 9). Distally it blends with the deep layer of the fibrous sheath of the flexor tendons (Fig. 6, 9).

Three important longitudinal septa unite the superficial palmar fascia with the volar interosseous fascia. The medial septum attached deeply to the transverse carpal ligament above and to the fifth metacarpal bone more distally, separates the flexor tunnel from the muscles of the hypothenar eminence (Fig. 4) and is pierced by the superficial

branches of the ulnar nerve and artery as they pass into the middle compartment of the palm. The lateral septum attached deeply to the first and second metacarpal bones lateral to the flexor tendons of the index finger separates the flexor tunnel and its contents from the muscles of the thenar eminence (Fig. 4). The middle septum passing deeply between the flexor tendons of the index and middle finger to the middle metacarpal bone divide the space between the medial and lateral septa into two definite fascial compartments—the middle palmar space and thenar space (Fig. 4, 5). As it passes in front of the flexor tendons of the index finger it forms the roof of the thenar space. Other more tenuous longitudinal septa form the lateral wall of the individual tunnel in which the flexor tendons lie. At first the adjacent septa which cover adjacent tendons lie in close apposition and the tendons which they cover. As the tendons diverge the septa become separated from one another or to leave narrow V shaped spaces in which run the digital nerve and artery and lumbrical muscles (Fig. 6) each covered by a thin layer of fascia which they derive as they pierce the fascial covering of the flexor tendons which they accompany higher in the palm.

As the septa which form the lateral wall of the flexor tunnel separate from one another

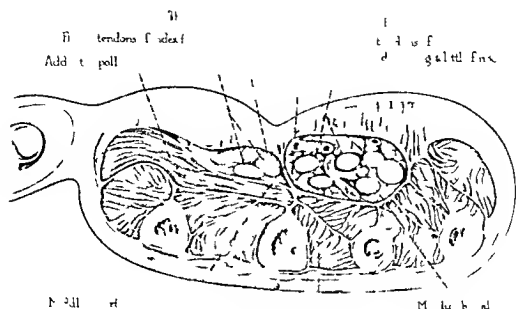


Fig. 4 (The proximal surface of the figure 9)

they increase in thickness and finally gain an attachment to the transverse metacarpal ligament the capsule of the metacarpophalangeal joints and the lateral aspects of the proximal phalange. By means of oblique fibers passing superficial to the flexor tendon sheath they gain an attachment to the opposite side of the proximal phalanges as well and help to form the deep layer of the digital fascia. Through the contraction of these fibers the digital nerves and blood vessels may be displaced from one side of the finger to the other (Fig. 10) and fingers not primarily involved in the contraction flexed and partially rotated from a normal position.

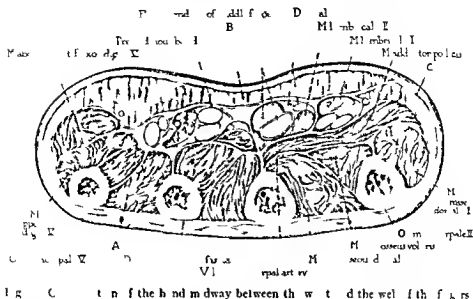
The superficial layer of the digital fascia (Figs 7-8) is the direct continuation of those fibers of the palmar aponeurosis which are not inserted into the skin and of the fasciculi transversi or nutritory ligaments mentioned above (Fig. 1). The deeper layer (Figs 7-8) which to the best of our knowledge has not heretofore been recognized as a definite structure is the continuation of the pratiniduous septa mentioned above which have gained an attachment to the capsule of the metacarpophalangeal joint to the sides of the proximal phalanges and by oblique fibers passing superficial to the flexor tendon sheaths to the opposite sides of their respective phalanges and to the fibrous expansion of the extensor tendon.

The digital nerves and blood vessels lie between the superficial and deep layers.¹

That these are not artificial distinctions may be demonstrated by making a median incision along the palmar surface of the finger down to the tendon sheath and reflecting the superficial tissues to either side. In every instance the digital nerves and vessels will be found to be reflected with the fascial layers. If on the other hand a lateral incision is made only deep enough to expose the digital nerves and vessels the fascial layer superficial to these structures may be followed to the opposite side of the finger and seen to be distinct from the deep layer which lies between them and the tendon sheath.

At the sides of the finger the superficial layer of the digital fascia is continuous with the superficial dorsal fascia. The deep layer is attached to the bone close to the attachment of the vaginal sheath and the aponeurotic expansion of the extensor tendon and the insertion of the interosseous and lumbrical muscles.

Fig. 5 (The proximal surface of the figure 9)



The flexion of the fingers that develops as the contraction of the palmar fascia progresses is due chiefly to the continuity of the superficial layer of the digital fascia with the longitudinal fibers of the palmar aponeurosis. The not infrequent deviation of the digital nerves and vessels from one side of the finger to the other results from the fact that they lie in a fibrous tunnel whose contracting walls are continually drawn proximalward toward the site of the primary involvement.

The dorsal fascia, as has been pointed out by Frohse and Fraenkel, consists of superficial, intermediate and deep layers. The superficial layer (Figs 5-8) covers the nerves and blood vessels and can be traced distalward on the fingers as a thin sheet superficial to the extensor tendons. The intermediate layer binds the extensor tendons into a single aponeurotic layer and may represent as has been suggested a dorsal tendinous plate or aponeurosis in which the tendons have later become differentiated. This layer may be followed to the metacarpophalangeal joints where it gains a firm attachment to the head of the metacarpal bones (Fig. 6). The expansion of the extensor tendons on the dorsum of the fingers is the digital continuation of this layer (Figs 7, 8). The deep layer of the dorsal fascia (Fig. 3, 5) covers the interosseous muscles and ends distally at the metacarpophalangeal joints.

PATHOLOGY

The essential change found in Dupuytren's contraction is a hypertrophy and contraction of the fascia of the hand. As the process advances the overlying skin becomes involved. Rarely, if the contraction has persisted a number of years, there are changes in the conformation of the bony surfaces, particularly at the proximal interphalangeal joint because of the long continued immobilization in acute flexion.

As a rule the process begins in the fascia of the palm as an isolated nodular thickening, most frequently over the flexor tendons of the ring finger (Fig. 11). As the disease progresses other nodules may appear in line with the first or similar nodules may appear over the flexor tendons of the little finger, the middle finger and the index finger in their order of frequency. The process may remain stationary for a number of months, but usually it progresses. A small pitlike depression develops just distal to the primary nodule and the skin is drawn upward in a crescentic fold with the convexity of the crescent upward (Fig. 12). After an interval which varies from a few months in some cases to ten or fifteen years in others, the finger in line with the affected fascial fibers is gradually drawn into a flexed position through the contraction of the thickened cord which has replaced what was once a thin fascial band. As a rule flexion

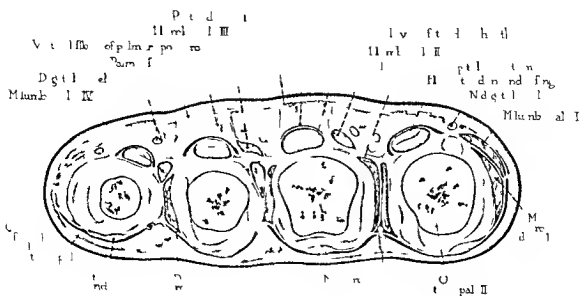


Fig. 6. Cr s t n f t h h a n d a l t h l e v e l f t h e m e t a c a r p o p h a l a n g e a l j o i n t s

takes place at the metacarpophalangeal and proximal interphalangeal joints while the distal joint is held in extension (Figs 13-16). Eventually the tip of the finger may come to lie upon or even press into the surface of the palm (Figs 16-21). As flexion increases the subcutaneous cord stands out more prominently from the surrounding tissues and becomes closely adherent to the thickened calloused overlying skin (Figs 17-18). Eventually the thickened skin loses all its normal characteristics and becomes so intimately united with the fascial cord that it is impossible to separate them (Fig 18). At times the adjacent normal skin is drawn away from the palm in a web like formation through which the thick fascial cord may be palpated as a taut bowstring (Fig 19).

In some cases one finger only is involved most commonly the ring finger or the little finger and the process remains limited to the finger in question. In other cases both the ring finger and little finger may be involved. Less frequently other fingers are affected either alone or in conjunction with others (Table IV).

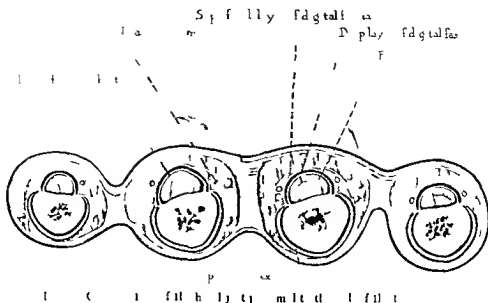
Little hand or both may be affected (Table III). If both are affected the involvement of the one usually precedes that of the other by several months or years.

A careful dissection of a hand involved in such a contraction shows as was first pointed out by Dupuytren and later by Sevestre

Line Schulthess and other investigators who were fortunate enough to secure specimens of such hands for dissection that only the fascia and the overlying skin are involved in the contraction the flexor tendons and their sheaths remain quite normal and the joint surfaces of the metacarpal bones and the phalanges show pressure changes only in rare instances. That the fascial involvement however is not limited to the superficial palmar fascia or aponeurosis has not been sufficiently emphasized. Thickening and contraction of the interfascial septa which unite the superficial palmar fascia with the volar interosseous fascia are not infrequently found and occasionally thickening of the dorsal fascia manifesting itself in the formation of nodules on the dorsum of the fingers is seen (Fig 21).¹

Since the degree of involvement may be greater on one side of the finger than on the other lateral deviation of the finger may take place and through involvement of the fasciculi transversus contraction of a finger adjacent to the one primarily involved may be marked. Not only are adjacent fingers involved in this fashion but other structures of the hand notably the digital nerves and blood vessels may be compressed or may be dis-

F h m t h o c t d l t h d l p t f h
t p h l g l j u n t w t h t h l t t f h h f m w h l
W h t p p m t h Q t l y J o u h t f M d
A d l l d t t t t t h m t m t h t t
f t h t f h l g b d t t k f m h t m t h t t
t t t f h l g b d t t k f m h t m t h t t



placed from their normal position. Displacement of a digital nerve the width of an entire finger was noted in one of our cases.

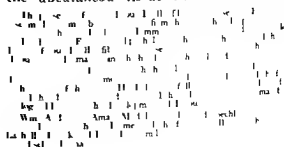
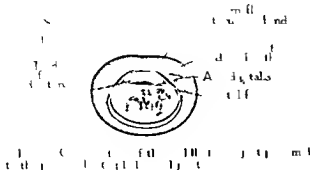
Microscopic examination of the skin and subcutaneous tissue in a well developed case of contraction shows a marked thickening of the corneal layer of the epidermis, a flattening of the deeper layer of the epidermis, gradual disappearance of the papillae of the corium and substitution of thick fibrous tissue for the normal reticular layer of the corium from which the fat and gland eventually disappear completely and in which the blood vessels are very markedly diminished (Figs. 2-5).

Microscopic examination under higher power of the fibrous tissue which has replaced the normal reticular layer of the corium shows masses of connective tissue cells with occasional areas of round cell infiltration (Figs.

6). Occasionally nerve fibers may be seen running through masses of connective tissue but there is no evidence to show that the nerve fibers have any part in the fibrous tissue formation (Fig. 7).

Occasionally when separating a digital nerve from the fibrous tissue which surrounds it one may see tiny millet seed sized nodules lying along the course of the nerve and attached to it by tiny fibrils. These are attached to the pod. These are the Leucocytic corpuscles and not pathological structure.

Although it is said that the plantar fasciitis may frequently show changes similar to those found in the palmar fasciitis in Dupuytren's contraction in only two of our cases was there involvement of the feet (Fig. 15). In a third patient who entered Wesley Memorial Hospital on the service of Dr. M. I. Colden because of a carcinoma of the cervix there was a typical bilateral involvement of the hand and a marked cord like thickening in the subcutaneous tissue of the sole of the feet.



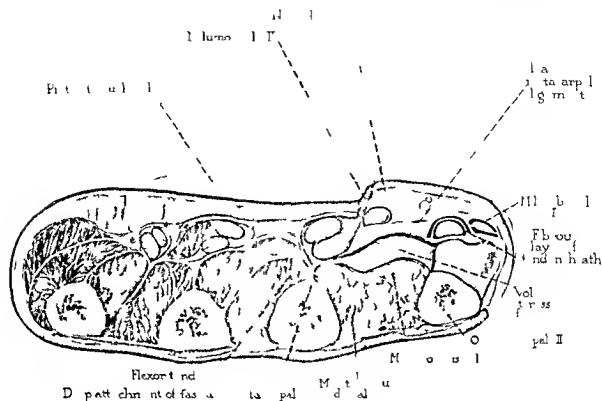


Fig. 28. Section to show the relation of the flexor tendons to the transverse carpal ligament and the fibrous layer of the flexor tendons (hemidiagrammatic).

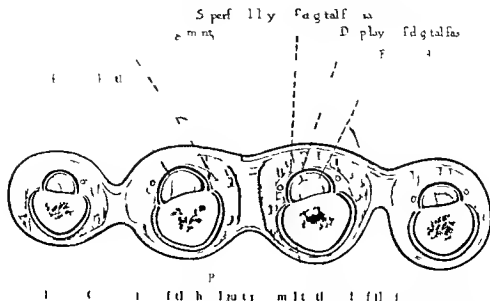
(Fig. 28) closely simulating the fusical thickening of the palm found in typical cases of Dupuytren's contraction before flexion contraction has occurred.

ETIOLOGY

Dupuytren's contraction is probably much more common in the later years of life than it is ordinarily considered to be. Among 500 men in the London Workhouses Noble Smith found 55 cases or 18.3 per cent; among 400 women 15 or 3.75 per cent. Of 270 men in the Nottingham Workhouse Black found 57 cases or 21 per cent; and among 168 women 3 cases or 1.8 per cent. Among 2,600 individuals of the poorer classes of London of whom about five sixths were past middle age Anderson found 33 cases or 1.7 per cent. Among 800 children in the Central District Schools of Hunsell there was not a single case. He states on the authority of Surgeon Captain A. H. De Lom that in five years (1885-1889) from a force averaging 20,000 men between the ages of 17 and 35 only 3 cases of contraction of the fingers came under treatment. Among 1,000 men at the Cook County Poor Farm Byford found 34 cases or 3.4 per cent. Among 106

women there were 3 cases or 2.83 per cent. Among 1,329 twist hands¹ in the Nottingham district Black found 23 cases or 1.7 per cent. He states that from 1900, to 1909 among 50,224 patients admitted to St. Thomas Hospital there were 21 cases of Dupuytren's contraction. Of 83,899 patients admitted to Wesley Memorial Hospital from January 1, 1916 to October 10, 1928 30 suffered from Dupuytren's contraction. Of these 8 were admitted on our service for operation and with a case from Ward 3 of the Cook County Hospital form the basis of this report. At least as many more in whom the disease did not cause any marked disability or in whom it accompanied some graver condition were seen by us in consultation during this period.

B l t f l t t h t l m l f t h l t t f l t l
th D p y t m l t h t t h l m l t t d t t l
t t t m p l t m p l t g t h l t h l f t l
l m h m l m d i i m t f 3 o h l
l l f d t 3 68 f f t f t d m g t h m l
th h h p t t t m t 7 l t t h g h f l
f t d h D p y t t t t t (57 f 7 m l m W t)
h d d f t h 7 h d k l l t w t h d d f t h p l y t
O f t p t t h d p t t h P t G l t h t l
f t t t h m t h t h f h l t l d d t h b



placed from their normal position. In placement of a digital nerve the width of an entire finger was noted in one of our cases.

Microscopic examination of the skin and subcutaneous tissue in a well developed case of contraction shows a marked thickening of the corneal layer of the epidermis, a flattening of the deeper layers of the epidermis, gradual disappearance of the papillae of the corium and substitution of thick fibrous tissue for the normal reticular layer of the corium from which the fat gland eventually disappear completely and in which the blood vessels are very markedly diminished (Figs. 2-25).

Microscopic examination under higher power of the fibrous tissue which has replaced the normal reticular layer of the corium shows much of connective tissue cell with occasional areas of round cell infiltration (Fig.

6). Occasionally nerve fiber may be seen running through masses of connective tissue but there is no evidence to show that the nerve fibers have any part in the fibrous tissue formation (Fig. 7).

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Although it is said that the plantar fascia may frequently show changes similar to those found in the palmar fascia in Dupuytren's contraction, in only two of our cases was there involvement of the feet (Figs. 15, 16). In a third patient who entered Wesley Memorial Hospital on the service of Dr. M. L. Goldline because of a carcinoma of the cervix there was a typical bilateral involvement of the hand and a marked cord like thickening in the subcutaneous tissue of the sole of the feet.

m l l
u r f n d s



The case of the foot is described in detail. The patient is a woman, 45 years old, who has been married 20 years. She has three children, two of whom are healthy. She has been suffering from a carcinoma of the cervix for several years. The disease has spread to the feet, causing a marked cord like thickening in the subcutaneous tissue of the sole of the feet. The patient is now in the hospital, and the disease is being treated with surgery.



decade in 6 during the third in 11 during the fourth in 5 during the fifth and in during the sixth. The average age at which the disease was first noted was 36.9 years. The average age of 57 men with Dupuytren's contraction seen by Black at the Nottingham Workhouse was 63 years. The average age of Byford's cases was 70.8 years. The average age of our patients on admission to the hospital was 48.3 years, the average duration of the disease 11.4 years.

In spite of the marked tendency to superficial fibrous tissue formation even in the colored races we have not seen a case of Dupuytren's contraction except in members of the white race.

The relative frequency of its occurrence in the two sexes and of its occurrence in individuals who constantly use their hands contrasted with those doing little manual labor such as clergymen, physicians, bankers, clerks, etc., are indicated in Tables I and II.

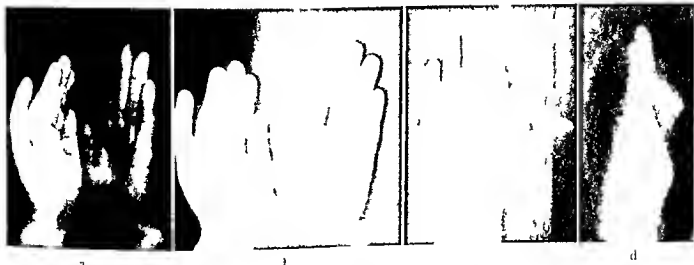


FIG. 11. Bilateral involvement of the palm and fingers. In 1, marked palmar nodule in the line of the little finger. In 2, operation.

FIG. 12. The right ring finger and a rather marked palmar nodule 5 months after operation.

TABLE III—HAND AFFECTED

Author	C	R	L	Bilateral
Keen	184	5	4	104
Anderson	39	10	—	4
Hume	118	—	—	4
Black	40	5	4	104
Byford	38	2	4	5
Kanawel Koch Mosen	22	4	5	—
	648	2	105	33

It is interesting to note that of the 29 cases reported by us in only 1 was the involvement unilateral and of these in only 4 was the right hand involved. In our 2 female patients the left hand only was involved and one of these was the only left handed patient in our series. Of 17 patients with bilateral involvement in 3 both hands were equally involved in 8 the right hand was involved the more and in 6 the left.

With reference to the sequence of involvement of the two hands data are difficult to secure. Keen states that in 6 cases of bilateral involvement the involvement of the left hand appeared first in 15 cases. Of Byford's 5 cases with bilateral involvement the involvement of the right hand preceded that of the left by 5.9 years in 10 cases that of the left preceded that of the right by 4.2 years in 8 cases. In 3 the involvement was practically simultaneous in 2 the relative time of appearance was unknown. In 4 of our 17 cases with bilateral involvement the involvement was

simultaneous. In 4 the right hand was involved first in one case 7 years in another or 3 years in another 10 years before the left was involved. In the fourth case in which involvement of the right hand had been present 3 years the patient did not realize that the left palm was involved until the nodules were called to his attention. In 9 cases the left hand was involved first. In 7 cases the interval was 1 year in 1 case 3 years in 2 cases 6 years in one case 7 years. In 2 cases the patient was uncertain as to the interval. In one case the involvement of the left hand in this case affecting chiefly the palm had been present for 10 years when involvement of the right ring finger appeared and in 9 months developed to the extent shown in Figure 14.

The part affected in 38 cases was recorded by Byford as the palm alone in 10 cases the fingers alone in 2 cases. In 26 cases both palm and fingers were affected. In all of our cases the fingers of one hand at least were involved in the contraction though among the 17 patients with bilateral involvement there were 9 in whom on one side the palm only was involved. In only one case were the fingers alone involved.

In 19 of our patients the contraction was first noticed in the palm. In 4 cases 3 of them with involvement of the little finger the trouble started in the proximal phalanx in 1 case it began in the middle phalanx of the ring finger. In 1 case with bilateral involvement

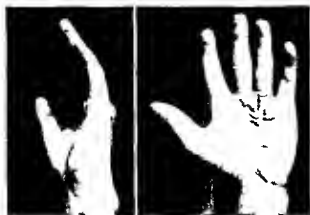


Fig. 1. Left hand: Flexion contracture of the ring finger. Right hand: Flexion contractures of the middle and ring fingers and the little finger.

the disease started in the left palm and remained confined to the palm of this hand 19 years later contraction began in the proximal phalanx of the right ring finger. In another case with bilateral involvement the process began at the proximal interphalangeal joint of the left ring finger and 7 years later in the palm of the right hand. In another case the trouble appeared simultaneously in the left palm and the proximal phalanx of the right fifth finger. In 2 cases there is no record as to the primary localization.

The interval between the recognition of the disease and the beginning of the contraction was noted as later several months later gradually contraction took place etc. It was stated specifically as several months or 3 months 3 months 6 months 1 year 1 year from to 3 years 4 years 9 years 9 years 13 years 16 years 17 years and 1 year in as many different cases. In one case beginning flexion at the metacarpophalangeal joint of the fifth finger first called attention to the disease.

The frequency with which the different fingers are involved is indicated in Table IV.

TABLE IV. FINGER AFFECTED

Author	Th	m	I	II	III	IV	V
K	4		4	3	99		
And	10	4	3		30		8
Byrd	15	4			3		
Koch							
Mason	0	4	3	0	3		
	3	3	3	4	34		38

In a statistical study of 103 cases Keen found the thumb was involved 9 times never alone the index finger 8 times alone 4 times with other fingers the middle finger 4 times alone the ring finger 13 times alone and the little finger 9 times alone. The middle and ring fingers were involved 1 time the middle and little fingers once the middle ring and little fingers 17 times and the ring and little finger 36 times.

Among our patients there was one case with bilateral involvement of all the digits. In 8 others there were subcutaneous nodules in the web between the thumb and index finger. In one patient who came under our observation (not included in this series of cases) there was a characteristic involvement of the thenar and band which extend from the thumb to the index finger just above and parallel to the web (Fig. 9). In no other case have we seen the entire fascial band involved. The index finger was involved 3 times never alone the middle finger 9 times never alone. The ring finger was involved 31 times 9 times alone and the little finger 21 times 6 times alone. The thumb middle ring and little finger were involved once the thumb ring and little fingers once the index ring and little finger once the middle and ring fingers twice the middle ring and little finger 4 times and the ring and little fingers 11 times. In 5 cases there was involvement of the right palm and in 4 of the left palm associated with involvement of both palm and finger of the other hand.

When several fingers of the same hand were involved the involvement of the different finger as a rule did not occur simultaneously nor to the same extent. In one patient with involvement of both ring and little finger contraction began in the ring finger and involvement of the little finger appeared soon after. In another case contraction of the ring finger followed that of the little finger after an interval of 6 years. In another similar case after an interval of 8½ years. In one patient with a marked contraction of the ring finger contraction of the index and little finger followed within two years after operation on the ring finger although there had been no evidence of their involvement at the time of operation.



Fig. 13. Dupuytren's contraction before and after operation. a) Before operation. b) Six months after operation.

With reference to the phalanges affected in cases of finger involvement Keen states that in 57 cases the proximal phalanx alone was involved 15 times the middle alone 7 times. The distal phalanx was involved 6 times. In 43 of 57 cases the proximal and middle phalanges were flexed. In 13 of the extension of the proximal phalanx preceded that of the middle in 3 flexion of the middle phalanx preceded. In 23 cases the order of occurrence was not stated. Of our 9 cases with 64 fingers involved there was flexion contraction at the metacarpophalangeal joint 30 times at the proximal interphalangeal joint 40 times and at the distal interphalangeal joint 9 times. Most commonly therefore there was flexion at the upper two joints and extension at the distal joint.

The cause of Dupuytren's contraction is still unknown. Many theories have been suggested for its origin have been vigorously upheld by their proponents and as vigorously opposed by others. Trauma either a single severe injury or the repeated traumatism associated with certain occupations or sports (Dupuytren Astley Cooper Adams Madelung Vogt Collis and Pateck Russ Ledderhose Gill Girdwood) a low grade local inflammatory process (Langenbeck Iubbs Ibsen Jones Whitman) systemic poisoning from lead (Michaud Lamache and Picard) from the toxins associated with various

constitutional diseases such as gout rheumatism diabetes arteriosclerosis etc (Guerrin Irgusson Little Keen Adams W Anderson Lulenberg Poggi Vogt Richer Teschemacher¹ Nichols) or from chronic dental infection (Byford) the loss of the protective layer of subcutaneous fat which is associated with advancing age (Madelung Ebstein) neurogenic influences (Abbe Neutra Teschemacher Coenen) embryologic malformations (Krogius) heredity (Adams Koenig Bunch Ibsen Keen Loewy) thyroid deficiency (Leopold Levi) or a combination of these factors have all been suggested at different times as the cause of Dupuytren's contraction. The relatively large number of fibers passing from the palmar fascia to the skin on the ulnar side of the palm and the slight decrease in the thickness of the skin on the ulnar side have been suggested by Russ as predisposing factors. The fact that the little and ring fingers are used more than the others in the act of grasping and flexed more tightly as the hand is closed has been suggested by Vogt as a predisposing factor.

Am g l l t T h mach f d 33 f D p y t
l t t p l h l d f m h b t th t th t t t
h h m y l l m f th k D p y t th t t t t
p t t d y f th k t th h d t t t
l l t p l t d l o s f th h d l t t phy f th g m f
l l t b l i t y f t t h l t t t t l y t h g m f
D p y t t h m h b l D p y t m p t t f
h p t t t h h p h d l d o d t p l m p t t f
h p l m f c t t t b y l D p y t m p t t f
T h m f m h m k t h m l q t l y d t p l t h m
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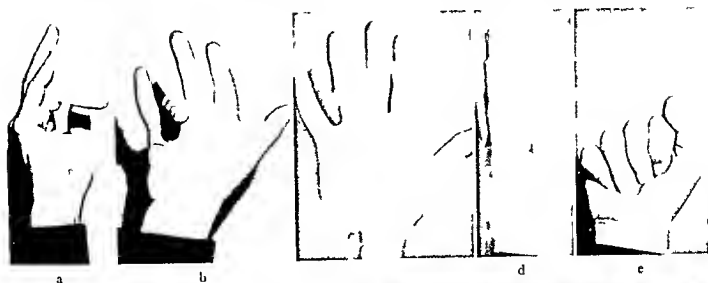


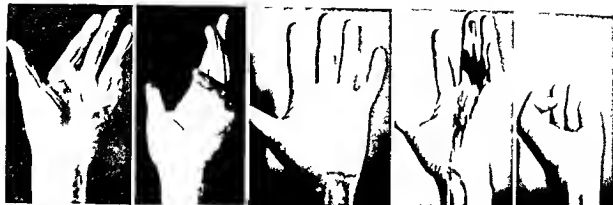
FIG. 15 Dupuytren's contraction of right hand (a e) a b Before operation c d e Nine months after operation f Bilateral thickening of plantar fascia in line of the great toes of the same patient

patient to having carried heavy sample cases a ninth to a lacerated wound at the base of the right little finger a tenth to a cut from a finger ring an eleventh to constant contact with the knob like top of the emergency brake of his car and a twelfth to holding tightly the bridle reins of his saddle horse. Two patients both bankers one of 70 years with a history of 10 years duration and one of 64 with a history of 5 years duration attributed the condition to the use of golf clubs.

These cases are cited in some detail because they are not convincing in establishing a definite and direct relation between the injury and the contraction. In the majority of cases there was a considerable lapse of time between the occurrence of the injury and the first signs of palmar involvement. In 2 cases in which the contraction was attributed to a definite injury (the first and fourth cases cited above) there was involvement of the palm of the opposite hand of which the patient had not been aware. It may be of some significance that both of these were industrial cases 1 e patients for whose disabilities their employers were financially responsible if it could be shown that the disability resulted from injury sustained in the line of duty. The eighth patient a physician who attributed the contraction of the right little finger to a lacerated

wound had a contraction of the left little finger almost identical with that of the right for which he had no explanation.

The frequency with which Dupuytren's contraction involves the left hand in unilateral cases the frequent involvement of both hands (Table III) the frequency with which it occurs in individuals doing little manual labor (Table II) the relatively infrequent occurrence of Dupuytren's contraction as compared with the infinite number of traumatism of the hand of the same general character as those cited above which are constantly sustained in the course of everyday life and work while all of negative value still make it difficult to believe that trauma is the essential factor in the causation of the condition.



b

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A second possible cause of Dupuytren's contraction a constitutional vice like gout or rheumatism was first suggested by Guerin in 1854 and this theory has found many adherents. Because of the frequency with which a history of gout or rheumatism can be obtained because the disease usually appears late in life because of its infrequent appearance in women who are as a rule exempt both from labor and from gout because of its frequent occurrence in non workers because of the frequent involvement of the relatively little used ring and little fingers because of the frequent involvement of the left hand as well as the right and because of the absence of any signs of local inflammation Keen felt convinced that the cause lie deeper than any local influence and that a constitutional vice like gout or rheumatism if sought for will nearly always be found.¹ Among 95 cases he found a distinct personal

Family history of Dupuytren's contraction
(Case) b Left hand before operation
Left hand 3 months after operation
Left hand 1 month after operation
(Thymic) 1 month after operation
Left hand 1 month after operation
Left hand 1 month after operation

or family history of gout or rheumatism in 64. He quotes Chevreton reporting a case in which the condition developed during an acute attack of rheumatism and reports a case of his own in which the disease followed within a few weeks after an attack of acute rheumatism.

In spite of these facts a careful inquiry into the past history of our patients failed to furnish a convincing argument in favor of the theory suggested. Seven of 29 patients gave a history of what might be called rheumatism but only one had had an acute rheumatic fever in the others the condition was described as slight slight aches and pains in legs and neck rheumatism of left shoulder for ten days rheumatism of both shoulder joints without fever periodical attacks of myositis of the back and chest etc. Seven patients gave a history of recurring attacks of tonsillitis, of gonorrheal infection and of both. One patient had had a chronic infection of the ethmoid cell for 10 years another an osteomyelitis of the arm at the age of 8 another nasal catarrh since boyhood. In other words the patients under observation had a record of past illnesses such as might be obtained from the average individual of the same age. In no case was a

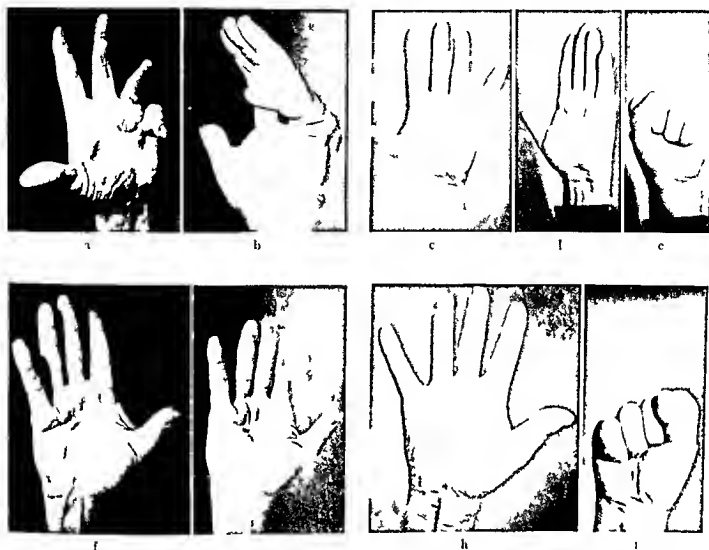


Fig. 19. Bilateral Dupuytren's contracture with marked deformity of left hand and palmar nodules at the base of the thumb (Case 2). a, b, Left hand before operation; c, d, Left hand 1 month after operation; e, f, Right hand before operation; g, h, Right hand 1 month after operation; i, j, Right hand before operation; k, l, Right hand 1 month after operation.

history of lead poisoning or of working in lead obtained.¹ Although several patients had had considerable dental work done only one had teeth which were described as being worn down and in poor condition and only two gave a history of dental abscess.

The third possible etiological factor hereditary although only occasionally noted in the cases reported in the literature of Dupuytren's contraction does not admit of controversy. Concerning the influence of an injury no greater than the traumatism which are constantly endured by manual laborers and individuals in every walk of life without permanent ill effects or concerning the causative effect of rheumatism a symptom complex as common as Dupuytren's contraction is uncommon one might argue at length. The occurrence of Dupuytren's contraction in successive generations however remains as a definite fact and it seems to us of some significance that the cases in which a familial tendency is recorded are often among medical men.



Fig. 1. Dupuytren's contraction of the hand. (a) Left hand, (b) right hand, (c) left hand, (d) right hand, (e) left hand, (f) right hand.

In other words, in individual who would be interested in learning the facts and who would like the trouble to establish them.

Six of our 9 patients were physicians. One stated that his father and paternal grandfather both suffered from a bilateral contraction of the ring and little fingers, another that his paternal grandfather had a bilateral contraction of many years duration with the ring and little fingers of both hands flexed into the palm, another that a male cousin suffered from Dupuytren's contraction.

Of our patients who were not physicians, one stated that his mother had a similar contraction of the left hand with involvement of the ring and little finger, his mother's sister had a similar contraction involving both hands and their father, the patient's maternal grandfather had a similar contraction of the right hand. Another patient's father and brother suffered from the same condition, two fingers of the father's hand were flexed half way into the palm, and the middle and ring finger of the brother's left hand were involved in the

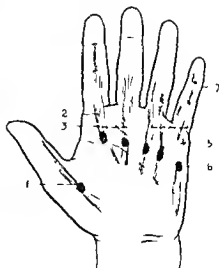


Fig. 2. Dupuytren's contraction of the hand. (a) Left hand, (b) right hand, (c) left hand, (d) right hand, (e) left hand, (f) right hand.

same fashion. Another patient stated that his mother suffered from a palmar contraction identical with his own. A fourth patient that a brother had the same trouble and a fifth that his father had several small hard nodules over the flexor tendon of the middle and ring finger of one hand but that the fingers were not flexed. Altogether 5 of 29 patients gave a definite familial history of Dupuytren's contraction.

With reference to the cause of Dupuytren's contraction, therefore, we can only say that it is still unknown. None of our patients gave a convincing history of a traumatic origin of the disease. In none could the development of the disease be traced directly to an antecedent infection or illness, to a toxic condition or to a lesion of the peripheral nervous system. Eight patients gave a history of a similar condition in other members of the family and this hereditary tendency stands out as the most definite and tangible factor in the development of the disease. That there are other factors goes without saying, but what they are we are unwilling to conjecture.

SYMPTOM

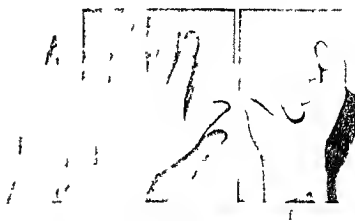
Subjective symptoms may occasionally be noted in the development of Dupuytren's contraction but they are uncommon. In 1 of our 9 patients complained of pain in the affected hand. One with a unilateral contracture



Fig. 1. Bilateral Dupuytren's contraction with flexion of 1st ring fingers and no nodule in the distal phalanx of the middle and little fingers on the left middle and ring fingers (Case 22). A 1st left hand before operation. 1st right hand 11 months after operation. A 1st left hand (not yet operated upon).

tion complained of an occasional cramping sensation in the affected finger and of occasional numbness. Another complained of a dull aching pain in the palm of the affected hand and at times of tenderness. A third and fourth said the palmar nodules were occasionally tender and a fifth that at times he had a slight aching pain in the affected finger. The majority stated that the entire process had developed without subjective sensations of irritation or pain.¹

The objective symptoms follow the pathological changes so closely that they scarcely require enumeration. The appearance of the primary nodule in the palm of the hand less frequently on the palmar surface of the ring or little finger, the development of other nodules, the gradual development after weeks, months, sometimes years of a progressively increasing contraction affecting most commonly the ring finger and next in order of frequency the little finger, the gradual secondary involvement of other fingers and of the skin overlying the contracted fascia, the complete retention of the power of flexion and of joint movements except as they are limited by the contracting band and the secondary contraction of the joint capsule—are all a part of the classical textbook picture of the disease.



DIAGNOSIS

In differentiating Dupuytren's contraction from other forms of contraction it is necessary to distinguish particularly contractions directly due to injury or infection, congenital contractions and spastic contractions. Contractions following lacerated wounds associated with infection, particularly infections of the tendon sheaths and contractions due to burns are readily distinguishable if a careful history is obtained. Several writers particularly W. Anderson and Black have stressed the importance of not confusing such acquired contractions with Dupuytren's contraction, particularly in attempting to secure statistical data from groups of elderly individuals whose memory for past events may be somewhat dimmed.

Sp kl d St b p t d f t s d t p th
th ms t f b th p lm d l d f t t b t th p ph l
p m t k f t t l l f th t t b t th p p f l
U d t t m e a m p t d t y b F h w t - H d M l
C p M d d t h - h d b d f m f t t f th
h d w h h t u i b d d t h k u n g f t h p
t l t t f t h f i d l g h t t t f t f t f t
p h l o s f t h p d m b t h t t d d t h m d
f h l g d t h y n u l m b t l e d T h f f t d d t h m d
m f g l j f t l y d l p d l o t b l p o c



b

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.

Congenital contraction and spastic contraction are distinguished by their history and by the fact that flexion at the wrist permits the affected finger to be extended since this movement produce relaxation of the tendon of the long flexor the structure primarily involved in such contraction. Flexion at the wrist does not permit of extension of the affected finger in Dupuytren's contraction since this movement does not relax the contracted palmar fascia. In both congenital and spastic contractions there is characteristically complete extension or even hyperextension at the metacarpophalangeal joint and flexion at the interphalangeal joint in direct contrast to Dupuytren's contraction in which flexion usually occurs first at the metacarpophalangeal joints and in which the distal interphalangeal joint is commonly unaffected. In both congenital and spastic contraction the limping and thickening of the palmar skin the gradual development of palmar nodules and later of thick cord in the line of the pretendinous band involving the fingers which are so definitely characteristic of Dupuytren's contraction are completely lacking.

Contraction of the finger due to gout and arthritis deformans should not be difficult of recognition pain tenderness and swelling involving particularly the joints are evidence of the symptoms on movement and the X-ray evidence of bone and joint changes leave no doubt concerning the diagnosis even if as rarely happen the process should be limited to one or two fingers on the ulnar side of the hand.

TREATMENT

Many methods of treatment have been suggested for Dupuytren's contraction and the literature of the subject contains numerous accounts both of successes and failures.

A. C. R. 15. Sir A. L. Cooper observed that the fingers are sometimes contracted by chronic inflammation of the tendons and the sheaths of the palm of the hand from excessive action of the hand in the use of the hammer the plough etc. When the tendons are contracted in this way should be attempted for the patient if no operation or other means will succeed but when the cause of the contraction and the contracted band is known it may be divided with pointed bistoury under the skin. The result is often good in the treatment. The result is often good in the treatment.



Fig. 23. Section of skin and subcutaneous tissue from palm of left hand shown in Figure 22 at the site of insertion of a fibrous band into the corium. Note the thickened corium, the irregularity of the deeper layer of the epidermis and the obliquity of the papillae and papillary vessels due to the upward retraction (to the left) of the contracting fibrous tissue ($\times 4$).



Fig. 24. Section taken from a palmar depression near the interdigital joint resulting from the contraction of a fibrous band terminating in the skin (Case 1). The thickening of the pit, the proximal edge of the epidermis, the corneal thickening, the disappearance of the papillae and the bottom of the pit, the dense fibrotic corium with traces of sweat glands or fat and with greatly thickened vascularity ($\times 28$).

then extended and a splint is applied to preserve it in the straight position.

In Dupuytren's *Leçons orales* one reads: "M. Dupuytren in treating several cases of contraction of the ring finger employed one after the other vaporized fumigations, first of an emollient and then of a sedative character, plasters, leeches, friction with resolvent ointments, particularly with mercurial ointments and calomel, alkaline simple sulphurous and saponaceous douches at various temperatures and all without the slightest success. As a last resort he prescribed permanent extension by means of an apparatus designed by Lacroix. No improvement resulted from the use of this instrument, on the contrary it caused such intense pain in the palm of the hand when the extension was maintained too long that its use was abandoned."

Some surgeons have proposed division of the flexor tendons. This operation has been performed twice. In the first case the tendon was cut in the center, the result was inflammation and mortification along the sheath, the patient's life was endangered and the finger remained flexed. In the other case the division was made lower, no complications arose but the part remained flexed as before.



Fig. 25. Section of skin from palm in close proximity to a palmar depression (Case 2). Note the thickened fibrous bands in the deeper layer of the corium ($\times 118$).

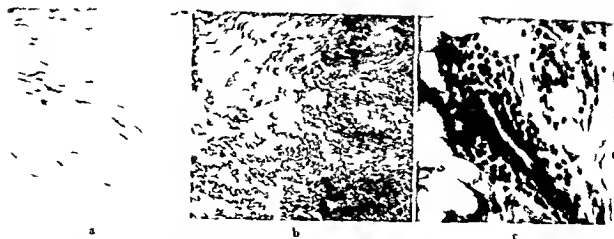


Fig. 6. Section of the ulnar nerve from the palm of the hand. The nerve is shown in the center of the incision. The incision is made in the palm of the hand, and the nerve is shown in the center of the incision. The incision is made in the palm of the hand, and the nerve is shown in the center of the incision.

Some time after these operations were performed and by excellent surgeons Dupuytren was consulted in a similar case by Dr. Maillay. The operation was performed June 12, 1831, by M. Dupuytren assisted by M. M. Maillay and Marc.

The hand of the patient being firmly fixed (Dupuytren) commenced by making a transverse incision ten lines in length opposite the metacarpophalangeal articulation of the ring finger. The bistoury divided first the skin and then the palmar aponeurosis with a crackling noise audible to the ear. The incision completed the ring finger straightened and could be extended almost as easily as in the natural state. Wishing to spare the patient the pain of a fresh incision Dupuytren endeavored to extend the section of the aponeurosis by gliding the knife transversely and deeply under the skin towards the cubital border of the hand so as to disengage the little finger but in vain he was only able partially to extend the insertion of the aponeurosis. He therefore determined to make a fresh transverse incision opposite the articulation of the first and second phalanges of the little finger and thus to detach its extremity from the palm of the hand but the rest of the finger remained fixed to this part. He then divided the skin and aponeurosis by a fresh incision opposite the articulation of the metacarpophalangeal joint. This produced a slight relaxation but its effects were incomplete. At length a third and last incision was made transversely opposite the middle of the first phalanx and the little finger was soon extended with the greatest ease. This showed that the last incision had divided the point of insertion of the aponeurotic digitation.

The bleeding was stopped by dry charpie and the hand was immobilized in extension. Following the operation there was considerable swelling and pain and on the fourth day suppuration was completely established. The wounds healed in twenty days by cicatrization. When the extension was removed more than a month after the operation the

patient could easily flex the fingers and was only inconvenienced by the stiffness resulting from the continued extension of the joints.

Goyrand in 1834 suggested making longitudinal incisions in the skin over the contracted band by dissecting the skin from them and cutting across the isolated cords. After division of the fascia the skin edges were reunited and the fingers fell in complete extension.

Busch also recommended the open operation. He dissected a triangular flap of skin from the contracted cord in the palm, divided all the bands of contracted fascia which could be reached and closed the lower part of the wound with sutures. After healing had begun cylinders of wool were laid in the hand to secure relaxation of the flexed fingers. Later dorsal extension was applied but only when the wound was covered with granulation tissue. He emphasized the employment of active and passive movements, the use of the hand bath for cleaning the wound and acceleration of the healing process by the use of skin grafts.

Fergusson emphasized the importance of open operation and excision of the contracted fascia so as to obviate the tendency to recurrence. He says of the tendency to recurrence, "so much is this the case that if the offending part were very superficial I should be inclined to dissect a portion of it out at once."

In many cases I believe this last named practice should be resorted to at first. An incision should be made lengthwise through the skin over the whole of the contraction and if the integument be tolerably soft and thick it should be turned off on each side so as to expose the fibrous tissue which should then be carefully taken away. In a few or all of these operations the utmost care should be taken to avoid the nerves and blood vessels at each side of the finger and if the stretching can be satisfactorily effected without opening a sheath or touching a tendon so much the better as then some movement might be expected afterwards but if the ten-



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I k 25 I Bl t l D
p v t n t t th f k
d k Bl t l t l f th
l t f n t l m p t t

use of a free full thickness graft of skin to replace the excised covering tissue.

Practically all of our cases have been operated on under local anesthetic. This may be accomplished by infiltration with 1 per cent novocain without adrenalin or by a combination of median and ulnar nerve block at the wrist and local infiltration.

After infiltration is complete the arm is raised for a few moments and vascular constriction is secured by inflating the blood pressure band applied before beginning the operation.

The incision used depends upon the extent and location of the fascial involvement. In cases with three or four nodules lying in a transverse line across the palm a transverse

incision is made which extends well beyond the nodules of either side. The incision is usually made in the line of the digital flexion crease of the palm. The skin is carefully raised above and below the incision so as to expose the fascia over a wide area as possible. Because the pretendinous bands are inserted into the corium it is very easy to button hole the skin as it is freed from the underlying fascia or to cut so close to it as to deprive it of its blood supply with the result that a portion of it may undergo antemic necrosis after operation. As the skin is elevated it is held out of the way with small flat retractor or a Kocher dissector. Every effort is made to avoid pinching it with the forceps or tearing it with sharp hooked retractor.



Fig. 9. Bilateral Dupuytren's band in the distal two-thirds of the

Fig. 10. Element of the fascial

With the palmar skin elevated as far as the incision permits, the ten capsule and fascia is divided transversely at the highest possible level, approximately on a line with the outstretched thumb. The moment the fascia is divided, some relaxation can be noted and the proximal end of the distal portion can be raised slightly from the underlying structures.

Beginning proximally, the fascia is separated by sharp dissection from its deep attachments—the intertendinous septa which bind it to the volar interosseous fascia—and from its lateral attachments. The farther distalward the dissection is carried, the more careful must one be to avoid injury to the digital nerves. These appear between the interdigitalations of the fascia as the pretendinous bands separate from one another to pass to their respective fingers. They lie in pairs, one for each side of the two fingers between which they lie. They are readily recognized when one is working in a bloodless field. As the dissection approaches the web of the fingers, one must be particularly careful to remove the fibers which pass deeply and merge with the transverse metacarpal ligament.

If instead of being confined to nodules lying across the palm, the disease has gone on to the formation of a firm contracted cord which cannot be completely removed through a transverse incision, a longitudinal incision is made of sufficient length to expose the contracted fascia in its entirety; the skin is reflected to either side and the fascia, including all of the contracted band with its deep and

lateral attachments is removed as completely as possible. It is in this type of case that particular care must be exercised to avoid injury of the digital nerves, since not infrequently they are displaced from their normal position by the contraction that has taken place (Fig. 10).

It is in cases with firm contracted cords that one must occasionally resort to skin grafting to supply the defect left by the excision of the hopelessly involved skin. In cases where the viability of the skin is in doubt it is better to excise the questionable tissue and fill the defect with a graft than to risk necrosis of skin along the line of suture with the possibility of infection and delay in healing. To suture skin whose vitality is in question and to suture it as one is usually compelled to do under such circumstances, under slight tension, is to invite necrosis, separation of wound edges, and a long drawn out convalescence. In filling the defect left by excision of devitalized skin we have found the free full thickness graft as described by Blair Davis and by ourselves in an earlier paper the most satisfactory method. In one of our early cases we used a pedunculated graft from the lumbar region to cover the defect left by excision of scar tissue, but the result was not as satisfactory as the results of the application of a free full thickness graft have been, and the disadvantages as far as the duration of treatment and the discomfort of the patient were concerned were considerably greater. We have not had occasion to use the tubed flap method in the treatment of such cases, but

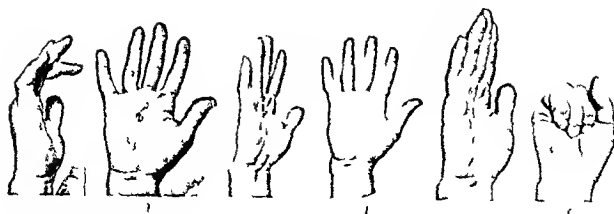


Fig. 30. 1. Incision on the palm. 2. Incision on the palm. 3. Incision on the palm. 4. Incision on the palm. 5. Incision on the palm. 6. Incision on the palm.

believe that in selected cases it might prove valuable if the tube were prepared and ready for transference at the time the palmar dissection was carried out.

In two of our earlier cases (1 and 2) an incision in the form of a Greek gamma (γ) was used and after excision of the involved tissue a free flap of fat from the abdominal wall was placed beneath the skin. In one case there was primary healing; in the other a low grade infection developed and there was a light discharge of serum and liquefied fat for week after the operation. In both cases the final result was good (Fig. 30) but no better than in subsequent cases in which no transplant of fat has been used.¹

In closing the operative wound fine suture material and fine cutting needles are used with Michel clips between every pair of sutures so as to evert the skin edges in an ectropion. Primary healing of the operative wound is of such great importance that it is worth while expending a little extra care to secure perfect apposition of skin edge—a more difficult task in the palm than in most part of the body. Heavy needles and coarse silk worm gut cause hole in the skin that permit the entrance of bacteria into the subcutaneous tissue and predispose to wound infection even eight or ten days after operation.

Fig. 31. 1. Incision on the palm. 2. Incision on the palm. 3. Incision on the palm. 4. Incision on the palm. 5. Incision on the palm. 6. Incision on the palm.

POSTOPERATIVE TREATMENT

With our earlier case we felt it was imperative after operation to plant the finger in extension so as to stretch the flexor tendon of the affected fingers which had been permitted to remain for months or years in a relaxed position. After the fingers had been kept extended for two or three weeks physical therapy was given to bring about a rapid restoration of function as possible. Because of the marked stiffness which resulted from immobilization in extension the period of plinting and immobilization was gradually shortened and in recent months we have used extension plint only in those cases in which there was marked shortening of the flexor tendon because of the long duration of the disease. Even in these cases splinting has been discontinued at the end of a week or ten days and as a result the restoration of function has been more rapid. Though we feared that contraction of the finger might tend to recur unless the flexor tendons were maintained in an extended position for a considerable period of time this has not occurred and we have come to believe that the shortening of the ligament about the small joints and the fibrous changes in these ligaments resulting from prolonged fixation in a flexed position are more important factors in preventing complete extension than the shortening of the flexor tendon and that immobilization only for the period of wound healing, physical therapy and active movement of the finger as soon as the finger is

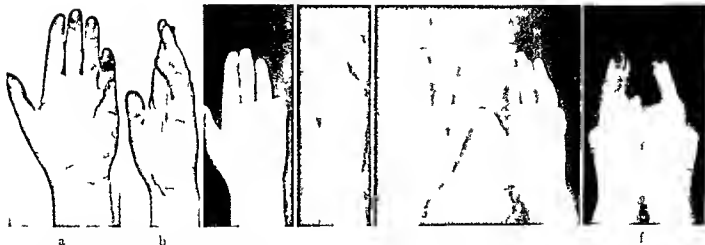


Fig. 31. Bilateral Dupuytren's contracture. (a) Preoperative view of both hands at time of admission. (b) Left hand 3 years after first operation (amputation of distal phalanx of left little finger). (c) Left hand 3 years after second operation (fat graft to palm). (d) Left hand 3 years after second operation (fat graft to palm). (e) Left hand 3 years after second operation (fat graft to palm). (f) Left hand 3 years after second operation (fat graft to palm).

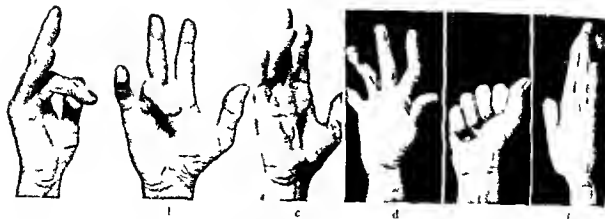
splitting the wound open by flexion of the fingers is past are the most important factors in overcoming this disability.¹

A word of caution may be added concerning the removal of the sutures. The thick skin of the palm of the hand does not heal as rapidly as the soft thin skin of the abdominal wall and sutures must be left in place until healing of all of the layers of the skin is complete. Clips should be removed in 6 or 7 days so as to avoid pressure necrosis from the metal points but sutures should be left in place for two or two and one half weeks. If small needle and fine suture material are used there will be no irritation or reaction as a result of the prolonged retention of the sutures.

Occasionally after operation we have noted a considerable degree of cellular infiltration evidenced by swelling slight redness and partial obliteration of the normal creases of the hand coming on as late as the fifteenth or

eighteenth day and requiring a considerable period of time to disappear. It has occurred most frequently in cases in which a narrow area of anemic necrosis developed in the skin along the line of incision and in which complete healing was delayed until the necrotic skin could be replaced by the ingrowth of epithelium from the adjacent healthy tissues. The slow disappearance of the exudate from the tissues has occasionally been very trying to patients and the process of absorption has not been appreciably accelerated by physical therapy in fact in such cases manipulation has seemed to increase the amount of cellular infiltration and delay the restoration of function.

Another condition which occasionally has been an annoying postoperative complication is that of numbness along the side of a finger or in several cases in which a transverse incision has been used in the area of the palm distal to the incision. This condition has at times developed in spite of every precaution to avoid trauma to the digital nerves and in cases in which the continuity and integrity of all the digital nerves in the area exposed has been satisfactorily demonstrated. In no case has the anesthesia been permanent but it has occasionally been so prolonged as to form a source of anxiety to the patient a fact that has impressed on us the necessity of handling the digital nerves as little and as gently as possible particularly when dissecting them free from enveloping masses of fibrous tissue.



RESULTS

Each of the cases operated upon has been carefully followed after operation the first 3 cases now for a period of 1 year and the result appraised with critical judgment.

In 20 of the 29 cases the results have been good from a surgical standpoint and completely satisfactory in the judgment of the patient. This group includes 2 cases in which primary nodules at some distance from the operative incision appeared within a year after the primary operation. In both cases the nodules were removed at a second operation and no subsequent trouble has developed since—a period of more than 3 years in both cases. In the two last cases of the series (8 and 29) the period that has elapsed since operation has not been sufficient to render certain judgment but their progress up until the present time lead us to believe that the result will be good.

In 5 cases (3, 14, 16 and 4) the results were fair. The first of these (Case 2) had been operated upon elsewhere twice before and as a result presented a particularly difficult problem. The second (Case 3) developed a bilateral recurrence following our first operation in the left hand because of incomplete removal of the palmar thickening at the primary operation in the right because we attempted to swing a flap of skin from the ulnar side of the hand in stead of filling the defect left by excision of devitalized skin with a free graft. The left hand was considerably improved by the second operation the right hand was not operated upon a second

time. The third and fifth cases (14 and 16) made an unusually slow recovery chiefly because of inadequate care in the later post operative period. In the 6 cases we believe the final result will be good. The fourth case (Case 14) cannot completely extend or flex the affected little finger but uses his hand in a normal fashion.

In (Cases 8 and 16) the result were definitely unsatisfactory. The first had been operated upon six times previously and finally had undergone amputation of several fingers. Needless to say complete restoration of function was scarcely to be hoped for. In the second case the prolonged fixation in acute flexion had caused a severe contraction of the periarticular structure of the metacarpophalangeal joint. Had this been compensated for by resection of the head of the proximal phalanx as suggested by Hutchinson the operation in our judgment would have been successful. Unfortunately the patient was unwilling to return for a second operation so that the result in this case must be considered a failure.

SUMMARY

Twenty nine cases of Dupuytren's contraction are reported which have served as an incentive for a careful study of the normal fascia of the hand and an opportunity for observing the unusual change which it undergoes in Dupuytren's contraction. Seven of these cases had been operated upon previously some of them more than once and in each case



Left hand (Case 1) Before operation (Fig. 31 a)

Right hand (Case 1) After operation (Fig. 31 b)

For some weeks in the harvest field of North Dakota. His soft hand became so stiff and sore that he could hardly open and close them. His disability gradually disappeared. Four or five years later the first nodules appeared.

He sought medical relief and for 6 months was treated by the application of a dressing saturated with a solvent solution. Since this was without effect, electrical treatment was given for some months with the aid of a static machine but also without any helpful result. In 1915 both hands were operated upon elsewhere through a Y-shaped incision. The hand healed very slowly. At the end of 6 months there was still an unhealed area a large 5 cent piece in the center of the left palm. When the hands were finally healed there was a firm scar at the base of the little finger of the right hand and a marked carrying of the left palm. About a year later the scars were divided subcutaneously and the hands placed in extension but with little improvement.

His hand had typhoid at the age of 21 and a gonorrheal infection at the age of 23 which cleared up rather rapidly but recurred a year later. His mother died in 1925 had involvement of both palms exactly similar to the condition of the patient in 1915. This began at the age of 64 years.

The condition of the left hand on admission in 1919 shown in Figure 31 a. b. Because of the firm scars present it was felt that a covering of normal skin was essential for a successful result. This was secured with considerable difficulty by the use of a single pedunculated flap from the abdominal wall. Because it had but one pedicle the flap was made thicker than ordinarily to ensure an adequate blood supply (Fig. 31 c, d). Because of infection which developed at the ulnar side of the flap some sloughing took place and the subsequent scar tissue formation produced a marked contraction of the palm and

kin over the little finger with a recurrent flexion deformity of this finger.

Three years later in 1922 the left hand was again operated upon and the contracted digital fascia of the ring and little finger was excised. Because of the extensive loss of skin over the palmar surface of the little finger and the very extensive fibrosis of all the tissues a complete excision of scar tissue was impossible and the contraction of the little finger again recurred. Because of its interference with his work a year later this finger was subsequently amputated and at the same time some of the excess fat removed from the palmar transplant. The final result is shown in Figure 31 e, f.

CASE 3 (W. M. H. 79767) Male 46 years minister. Twenty years before admission on the patient first noticed small indentations of the palm of the right hand. Two or three years later a similar condition appeared in the left hand. Four years before admission flexion contraction of the right index finger began and gradually reached the degree shown in Figure 32 a, b.

He had had rheumatism when 13 years of age. June 2, 1919 under gas and ether anesthesia through a 4 inch pedicle incision with the anastomosis opposite the distal flexion crease and the distal portion of the radial limb extending 3 centimeters along the midline of the ring finger the affected palmar fascia was excised and a free flap of fat from the right thigh interposed between the skin of the right hand and flexor tendons. The wound healed by primary union.

Figure 32 c shows the condition of the hand 15 months after operation. One year later in September 1924 five years after operation and the left hand which was not operated upon in September 1914

CASE 4 (W. M. H. 101583) Male 44 years miner. Five years before admission he noticed a gradually developing flexion deformity of the right



Fig. 36 Dupuytren contraction with bilateral involvement of little finger (Case 5)

little finger and later involvement of the ring finger. Three years before admission the left little finger and ring finger became involved. Since the age of 9 he had worked as a coal miner with pick and shovel.

Twenty years before admission he had had a gonorrhoeal infection with exacerbations 1 year before admission he had had attacks of malaria.

Both hands were operated upon June 6, 1922. In both there was marked involvement of skin as well as deeper structures. On the right side an incision was made in the form of an inverted L (Γ) with the vertical limb extending upward on the ulnar side of the hand and the transverse limb across the palm to the midline of the hand approximately in the line of the distal flexion crease. Three firm cords of contracted fascia were found, two arising from a single band higher in the palm and involving adjacent sides of the little and ring fingers, and a third on the radial side of the ring finger. After wide excision of the involved skin and fascia the skin flap was rotated radialward on its base so as to compensate for the excision of hopelessly fibrosed skin and the wound sutured. On the left side vertical incisions were made in the median line of the ring and little fingers and the contracted cords removed through these incisions.

The left hand healed well but on the right some necrosis took place because of tension on the sutures and healing was not complete until 4 weeks after operation.

Four months after operation the patient returned because of recurrence of the condition in the left hand. October 2, 1922, under local anaesthesia the palmar fascia on the ulnar side of the hand which had not been excised as completely as it should have been at the first operation was carefully removed. A small defect in the skin covering was filled with a free full thickness graft, the first to be used by us in such a case.

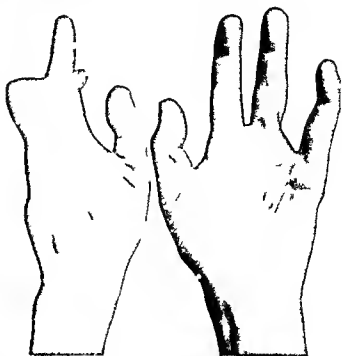


Fig. 33 Bilateral Dupuytren's contraction of 18 years duration (Case 8)

Figure 33 a shows the result 18 days after the second operation on the left hand and Figure 33 b c d e the result in both hands 2 years after operation.

CASE 5 (W. M. H. 112301) Female 59 years housewife left handed. Eight years before admission the patient noticed a small painless nodule on the ulnar side of the left palm. Two or 3 years later flexion contraction began in the ring finger and soon after in the little finger. She occasionally noticed cramping sensations and numbness in the affected fingers.

Fifteen years before admission she had had arthritis of both shoulder joints unaccompanied by fever.

At operation under local anaesthesia May 1, 1924, through a vertical incision in the line of the pretendinous band of the little finger the involved fascia was excised and the hand splinted in extension.

Figure 34 a shows the condition before operation b c the result 5 months after operation.

CASE 6 (W. M. H. 114870) male 40 years physician. Two years before admission the patient first noticed a small nodular growth on the palmar surface of the left little finger at the level of the proximal interphalangeal joint. This gradually increased until several months later when he noticed that he was unable completely to extend the little finger. The contraction gradually increased until at the time of admission the patient was unable to extend the little finger at the metacarpophalangeal joint beyond a right angle. There were no subjective symptoms of pain or tenderness. There was no history of local infection or injury.



Fig. 35. Bilateral Dupuytren's contracture (Case 7). Left hand after operation. Right hand before operation. Left hand after operation. Right hand before operation.

He had had tonsillectomy at the age of 25, frequent attacks of tonsillitis until the tonsils were removed at the age of 30, and pneumonia followed by bilateral emphysema at the age of 33.

He stated that a cousin suffered from the same condition.

October 8, 1924, under local anesthesia the palmar fascia on the ulnar side of the hand and a thick cordlike mass of fibrous tissue lying on the ulnar side of the left ring finger and attached distally to the fibrous tissue overlying the flexor tendons and to the fibrous tissue and periosteum on the ulnar side of the middle phalanx were excised through an elongated zigzag incision. A left inguinal hernia was repaired at the same time.

There was some necrosis of the skin edges along the line of incision which delayed healing but the patient left the hospital 3 weeks after operation with the wound healed. After discharge from the hospital physical therapy was begun and continued for a number of weeks. Figure 35 shows the condition of the hand in January, 1927, 2 years and 3 months after operation. Flexion of the fingers was not impaired at any time.

CASE 7 (W. M. H. 117176) male 42 years. Physician. Sixteen years before admission he sustained a light laceration of the palmar surface of the left hand at the base of the little finger. A slight flexion deformity gradually developed as a result. Six years later he first noted puckering and hardening of the skin of the right palm at the base of the ring and little fingers which gradually went on to a flexion deformity at the metacarpophalangeal joint of the little finger (Fig. 36). There were no subjective symptoms except slight aching pain at times and the inability to extend the fingers completely.

He gave a history of pyrexia and headaches of unknown etiology 12 years before admission of typhoid and phlebitis of the left leg and right arm 5 years later.

At operation in February 18, 1925, under local anesthesia a zigzag incision was made along the

ulnar side of the right little finger. The cord of fibrous tissue extending from the little finger area of the palm to the proximal interphalangeal joint were carefully dissected out. The larger and stronger radial cord was firmly attached to the living skin but superficial to the digital nerve. The digital nerve on the ulnar side was intimately united with the fascial cord.

The patient was discharged from the hospital days after operation. Some dry necrosis of the edges of the skin along the line of incision occurred with subsequent superficial wound infection. Healing was complete with the finger in extension 3 weeks after operation but numbness along the ulnar side of the finger persisted for a number of months after operation. The left hand is not operated upon.

CASE 8 (W. M. H. 10058) male 57 years. Physician. Thirty-two years before admission at the time of his graduation from medical school the patient noticed nodules developing in both palms. He had always been in good health except for periodical attacks of myositis.

His father had a bilateral contraction of the fourth and fifth fingers and his paternal grandfather had a similar condition.

He was operated upon by three different surgeons by one of them on six different occasions. In his own words the tendency as to recurrence and the recurrence plus scar tissue caused disability so extensive that several fingers were amputated. About 3 years before admission in June, 1925, a growth appeared on the scar tissue on the ulnar side of the right middle finger and this became so painful and distressing that he again sought surgical relief not with the idea of having the contraction cured but because of the painful nodular growth. It was possible to excise this as well as some of the scar tissue holding the finger in flexion and had he been willing to undertake physiotherapeutic treatment and at a splint for some time the condition could probably have been

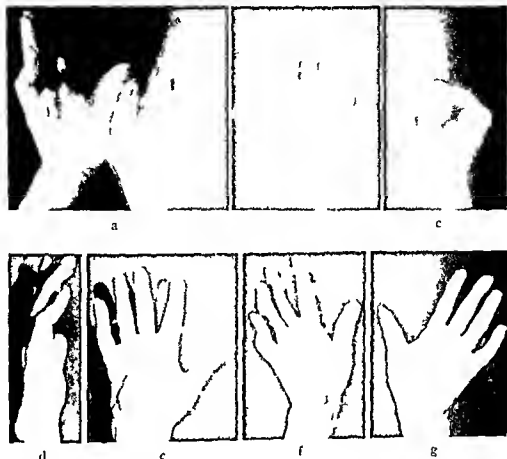


Fig. 13. Bilateral Dujovitz contracture (a) Left hand before operation (b) Left hand after operation (c) Right hand before operation (d) Right hand after operation (e) Left hand 14 months after operation (f) Right hand 14 months after operation (g) Left hand 14 months after operation

improved. As it is he writes that he has had very marked comfort and freedom from pain but the right middle finger has again contracted to about a right angle (Fig. 37).

CASE 9 (W. M. H. 119094) male 41 year Y. M. C. A. secretary. Four years before admission the patient first noticed callus formation in the left palm which gradually became more marked and more nodular in character. Later contraction developed which involved the ring finger and middle finger and which at first progressed very slowly but during the year before admission more rapidly. The patient ascribed the involvement to constant use and irritation of the hands in various sports particularly baseball. He had noticed in the 6 months preceding admission that the hand became very sore and stiff when it was used particularly in the sports to which he had been accustomed. He had had a slight attack of rheumatism at 29 year.

The appearance of the hand before operation is shown in Figure 12. There was a definite subcutaneous nodule also in the web between the thumb and index finger.

June 3, 1925 under local anesthesia the involved fascia was excised through a longitudinal incision in line with the interspace between the ring and middle

fingers. The nodule between the thumb and index finger was removed through a second incision on the dorsal surface just over the area involved. The fingers were splinted in extension. Following the operation there was a slight necrosis of the skin edges along the line of incision. The patient left the hospital with the wound healed 15 days after operation.

Six months later the patient wrote: "I can straighten my fingers but it is like pulling again at stiff rubber bands. The joint of the middle finger is still sore and stiff. The latter condition probably resulted from the prolonged extension of the finger on a dorsal splint, a method of postoperative treatment which has since been abandoned."

CASE 10 (W. M. H. 119193) male 70 years banker. Ten years before admission the patient noticed a lump at the base of the left little finger which he thought a callus caused by his golf clubs. Contraction gradually took place. Some time later he could not say definitely when a similar condition developed in the right hand. The patient ascribed the condition to the constant trauma of the hands associated with playing golf. He complained of some tenderness of the nerves of the left hand.

He had had inflammatory rheumatism as a young man.



Figure 1. a b c d e f g h i j k l m n o p q r s t u v w x y z

At peritonitis under local anesthesia on the left hand June 4, 1935 a vertical incision was made in the line between the ring and little fingers. The palmar fascia was widely excised and the hand placed in extension. The right hand was not operated upon.

Figure 35 a b shows the condition before operation c d the condition 9 months after operation.

CASE 1 (W. M. H. 11033) male 35 years old triax. Three years before admission the patient punctured the skin over the palmar surface of the right ring finger at the level of the metacarpophalangeal joint with a piece of copper wire there was a slight infection of the wound which subsided within a week. Some time later a nodule appeared at the site of injury and later contraction developed which at the time of admission had healed. The leg was healed in Figure 11 a b.

The patient gave a history of frequent cold but no other illness. There were thick calluses over the bases of the proximal phalanges on both palms.

September 14, 1932 under local anesthesia a longitudinal incision was made in the skin over the palmar surface of the right ring finger as far as it could be reached. The wound was closed. The hand was placed in extension and the patient left the hospital 4 days after operation. The wound healed by primary union.

May 5, 1933 the patient returned to the hospital with furunculosis in the subcutaneous tissue of the right palm two at the level of the distal flexor tendons of the palm in the line of the little and ring fingers respectively. One at either side of the middle flexor tendon in the line of the middle finger. These abscesses were drained on the following day through a transverse incision in the skin over the flexor tendons. The patient left the hospital 14 days later. The abscesses healed by primary union and there has been no further abscesses since.

Figure 1 shows the range of movement of the fingers 6 months after peritonitis.

CASE 2 (W. M. H. 11063) male 51 years old carpenter. Four years before admission he had a block of wood 5 or 60 pounds in weight fell on his patient's left hand. It cut just through the skin of the ring finger. The hand was in extension and the patient paid little attention to the injury. A month later he noticed a nodule forming at the site of injury. The nodule gradually increased in size until 3 years after the injury when contraction of the ring finger first became apparent. At the beginning of the contraction (1934) the hand was a little difficult in putting on his glove because of the flexion contraction at the end of the finger he was unable to put a glove on the affected hand (Fig. 13 a b).

He had had measles and scarlet fever in childhood and appendicitis followed by a postoperative pneumonia 14 years before admission. He had had rheumatism of the left humerus 10 years before admission and rheumatism of the right shoulder 3 years later. He had had malaria in his teeth 2 or 3 years before.

September 23, 1935 under local anesthesia the contraction of the palmar fascia was excised. The hand was placed in extension. The wound was closed. The patient left the hospital 10 days after operation. The wound healed by primary union. The hand was placed in extension. The patient left the hospital 10 days after operation. The wound healed by primary union.

A month after leaving the hospital the patient noticed a dimpling and retraction of the skin at the level of the little finger. The dimpling was a small nodule. The patient was not aware of it at the time. The patient was not aware of it at the time. The patient was not aware of it at the time.



Fig. 41 Dupuytren's contraction of left hand. (a) One year after operation (note the elongated oval wound healed by primary union). (b) One year after operation (note the elongated oval wound healed by primary union). (c) One year after operation (note the elongated oval wound healed by primary union). (d) One year after operation (note the elongated oval wound healed by primary union). (e) One year after operation (note the elongated oval wound healed by primary union). (f) One year after operation (note the elongated oval wound healed by primary union).

left the hospital on the fourth day. The operation wound healed by primary union. At that time no nodules were noted for the first time at the base of the ring and little fingers of the right hand. Figure 13 c d shows the appearance of the hand and the range of movement of the fingers 3 months after operation.

CASE 13 (W M H 13230) male, 44 years, collector. Six years before admission while serving in the United States Navy the patient noticed callus like formations in the palms of both hands. Gradually cord like thickenings appeared in each hand which drew first the ring finger and later the little finger down toward the palm.

Eight years before admission he had an attack of influenza followed by meningitis.

In June 1925 the left hand was operated upon elsewhere. Recurrence of the contraction occurred soon after.

In August 1925 the right hand was operated upon elsewhere and the fingers kept in extension for 6 weeks afterward. Following the operation the fingers remained stiff the patient was unable to flex them and the flexion deformity at the proximal interphalangeal joint of the little finger began to recur.

January 26 1926 the left hand was operated upon under local anesthesia. An elongated oval of dense superficial scar tissue was carefully dissected out the skin elevated at either side and the involved fascia removed. The oval defect in the skin was covered with a free full thickness graft. The appearance of the left hand before and after operation is shown in Figure 39 a b c.

February 4 1927 the right hand was operated upon under local anesthesia. The thickened palmar fascia on the ulnar side of the hand was carefully excised and the flexor tendons of the middle ring and little fingers examined. They were firmly held within the flexor tunnels by fibrous tissue and the superficial flexor tendons adherent to the deep flexor tendons. Extension of all the fingers was almost complete (Fig 39 d e) following the opera-

tion. Flexion greatly improved with the aid of a splint and four weeks of physical therapy.

March 1928 the scars over the proximal portion of the right ring finger and over the hypotenar region were excised and the resulting defects covered with free full thickness skin grafts.

CASE 14 (W M H 13379) male 64 years, laborer. Twenty years before admission the patient noticed the formation of a nodule on the palmar surface of the proximal phalanx of the left little finger. Gradually other nodules appeared in the palm in the line of the ring finger and 5 years before admission he noticed a beginning flexion contraction at the proximal interphalangeal joint of the little finger which gradually continued until the second phalanx was flexed to an angle of 45 degrees on the first phalanx. About 15 years before admission the patient noticed a subcutaneous nodule in the right palm with beginning retraction of the skin in the line of the ring finger at the level of the distal flexion crease. He thought that it developed after he had knocked to pieces some old boxes with a very heavy hand ax. He ascribed the disease in the left hand to irritation from the head of his putter while playing golf.

The patient gave no history of past illnesses or infections.

February 3 1926 under local anesthesia through a vertical incision in the midline of the little finger the affected fascia was carefully excised. Many tiny millet seed sized white bodies were noted lying along the digital nerves and attached to them by tiny fibrils as peas are attached to a pod. These tiny bodies proved on microscopic examination to be tactile corpuscles.

The fingers were splinted in extension. The operative wound healed by primary union but the site of operation gradually became swollen slightly inflamed and tender as though by a diffuse cellular infiltration of the tissues about the site of operation. This condition in spite of baking massage and physical therapy subsided very slowly and pre-

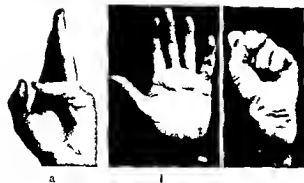


FIG. 40. Blistered pyrolytic material (C. O.)
 (a) Before operation. (b) 13 months after operation.
 (c) 13 months after operation.

entire use of the hand particularly flexion of the fingers for a period of 6 weeks after operation.

At one half year after operation he reported that the use of all of the fingers of the right hand excepting the finger that was operated upon but have difficulty in completely closing the other fingers in fact if I attempt to get them loose to the palm of the hand I can feel a pain in the knuckles. I can grasp any object in doing any kind of work such as shoveling coal in the furnace without difficulty. The lump in the palm of the hand has entirely disappeared.

Figure 40 shows the condition of the hand before operation and two and one half years after operation.

CASE 15 (W. M. H. 13809) male 55 years, claim adjuster for state railways. Fourteen months before admission the patient's left hand was bruised by a gauger's tool. Some months later he noticed a lump in the palm at the head of the fourth metacarpal. Five or six months after the injury he noticed an increase in size of the lump, beginning contraction at the metacarpophalangeal joint. Swelling of the palmar skin.

There was no history of illness except that of frequent colds, the hands had been cold and contracted in other members of the patient's family.

There were subcutaneous nodules just above and below the distal flexion crease in the line of the ring finger and a smaller nodule just below the crease in the line of the middle finger. There was marked puckering, lumping and induration of the palmar skin in the line of the ring finger and slight beginning contraction of the ring finger (fig. 41 a, b).

On March 2, 1906, under local anesthesia the contracture of the ring finger was released through a longitudinal incision with the fingers extended.

The patient left the hospital a day later with the hand completely healed. The result is shown in figure 41 c, d, e, f.

CASE 16 (W. M. H. 13810) male 36 years, salesman. Fourteen years before admission he noticed a dimpling of the left palm at the junction of the distal flexion crease and the proximal crease. Nine years later he noticed beginning flexion deformity of the little finger. One year before admission he was unable to put the finger in glove and noticed that the nail of the little finger began to press to the palm. Two or three months later diminution of flexion of the ring finger followed and the extensor progressed with rapidity. The condition shown in figure 42.

The patient attributed the onset of the trouble to having carried heavy mail bags and having pulled on a strap. He never noticed any other changes in the hand but two small hard nodules on the first and middle and ring fingers. The hand was then flexed.

The patient was treated by frequent use of the elevator for a year and a half. The result is shown in figure 43 a, b, c, d, e, f.

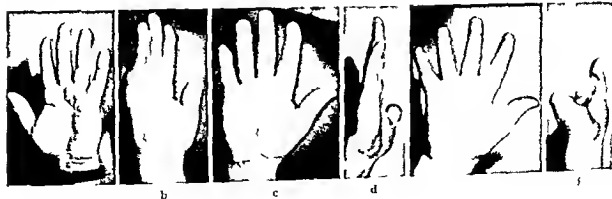


FIG. 43. Blistered pyrolytic material (C. O.)
 (a) Before operation. (b) 13 months after operation.
 (c) 13 months after operation. (d) 13 months after operation.
 (e) 13 months after operation. (f) 13 months after operation.

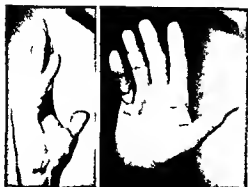


Fig. 14 Dupuytren's contraction with marked limitation of palmar skin and contraction of right little (Case 4)

At operation under local anesthesia November 23, 1926 the contracted fascia was excised through a vertical incision over the little finger parallel with the contracting band and a second vertical incision over the proximal phalanx of the ring finger. A small free full thickness graft was used to cover a defect over the distal portion of the palm between the affected fingers. The hand was splinted in extension.

After the operation the patient suffered considerable pain because of the tension required to maintain the fingers in the extended position and the resultant pressure on the dorsum of the extended finger. It finally became necessary to relieve the tension with the result that the pressure over the skin graft was released and subsequently necrosis of the graft took place. Ten days later the raw surface was covered with a Thiersch graft and wound healing took place without further difficulty. In the meantime however because of the relaxation of tension and continued immobilization the little finger again became partially flexed and the final result was unsatisfactory. In spite of repeated attempts we were unable to persuade the patient to return for a second operation.

In this case it might have been wiser to have resected the head of the proximal phalanx as suggested by Hutchinson so as to shorten the bony framework and thus compensate for the shortening of the articular ligaments.

CASE 17 (W. M. H. 128884) male 64 years examiner for civil service commission. Seven years before admission the patient noticed a beginning callus formation on the palm at the base of the little finger. An ointment was applied at the advice of a dermatologist but without effect. Gradually a contraction developed at the metacarpophalangeal joint which prevented complete extension of the finger. Three years before admission the hand was operated upon under local anesthesia the tendon of the little finger pulled out and scraped. There was no improvement but the contraction gradually increased. A year before admission involvement of



Fig. 15 Dupuytren's contraction with pathologic condition (Case 5)

the first noticed. The condition of the hand upon admission is shown in Figure 15. At that time there was also palmar involvement of the right hand but no contraction of the fingers. The patient had a gonorrheal infection at the time of operation for tuberculous glands of the neck at 4 years. He had had the disease within the 7 years preceding.

The patient suffered from a similar condition. On November 3, 1926 under local anesthesia the contracted fascia of the left hand was excised through a vertical incision beginning distally over the base of the little finger and curving radially toward the base of the thenar eminence. The hand was splinted with the fingers in extension. The patient left the hospital 5 days after operation. The wound healed by primary union.

December 31, 1927 the patient reentered the hospital for operation upon the right hand in which contraction of the ring and little fingers was then becoming apparent. The same day under local anesthesia the affected fascia was excised through a transverse incision in the line of the middle flexion crease of the palm. Particular attention was directed toward excising the paratenar septa connecting the palmar aponeurosis with the volar interosseous fascia. The patient left the hospital 3 days after operation. The wound healed by primary union.

Figure 17 c d e shows the condition of the left hand November 17, 1928 almost two years after operation and Figure 17 f g h the right hand on the same date 10½ months after operation. The patient himself feels that he has had a complete restoration of function.

CASE 18 (W. M. H. 129451) male 56 years wine merchant. Twenty one years before admission the patient's left hand was caught between two casks. Within a year a nodule appeared at the level of the distal flexion crease of the palm in line with the cleft between the ring and little fingers. A slight contraction developed and remained practically unchanged during the following 20 years (Fig. 14 a).

One year before admission the patient's right hand was struck with a wrench. Some time later a

CASE 21 (C C H 1038589) male 5 years plasterer. Three years before admission the patient first noticed a callus in the palm of the left hand at the junction of the distal crease and the pretentious band of the ring finger. Gradually flexion contraction of the ring finger and little finger developed until at the time of admission the proximal phalanx of the ring finger was held at an angle of 140 degrees or 145 degrees with the corresponding metacarpal bone, the proximal phalanx of the little finger was held at an angle of 125 degrees or 130 degrees and the middle phalanx of the little finger was flexed to an angle of 90 degrees on the proximal phalanx. The range of movement of the other joints was normal.

The patient ascribed his condition to constant irritation of the hand with a plasterer's tool. He gave no history of local or general infection or of a similar condition in other members of the family.

November 18, 1917 under local anesthesia the affected fascia was excised through a longitudinal incision from the proximal flexion crease to the proximal interphalangeal joint of the ring finger and through a second shorter longitudinal incision in the line of the little finger. The hand was splinted with the fingers in extension. The wounds healed by primary union and the patient left the hospital 10 days after operation with the fingers completely extended without tension.

CASE 22 (W M H 136397) male 36 years supervisor of a finance corporation. As long as he could remember the proximal interphalangeal joint of the left ring finger was slightly enlarged. About 25 years before admission he noticed a beginning flexion which gradually increased until extension was limited to 65 degrees (Fig 21 g h). Seven years later a similar condition developed in the right ring finger and progressed until extension at the proximal interphalangeal joint was limited to 60 degrees (Fig 21 a b c). In the 15 years previous to his admission nodules appeared on the dorsum of the fifth and middle fingers of the right hand (Fig 21 a b c) and the ring and middle fingers of the left hand (Fig 21 g h). In each case they were over the proximal interphalangeal joint, the largest 3/8 inch in width on the right fifth finger was in a median position, the others smaller in size lay to the ulnar side of the finger affected.

This patient gave no history of injury which might have caused the condition. He had had occasional sore throats until 4 years before admission when his tonsils were removed. He had had 2 gonorrheal infections, 16 and 12 years before admission. No other members of his family were similarly affected.

January 25, 1928 under local anesthesia the fascia of the right hand was widely excised through an elongated S shaped incision at the ulnar side of the ring finger extending from the middle of the middle phalanx upward to the middle of the palm. The digital nerve at the ulnar side of the ring finger was displaced radialward by the contracting band and the natatory ligament between the ring and

little fingers pulled sharply upward. The dorsal nodule lying over the proximal interphalangeal joint of the right middle finger was also excised. It lay in the subcutaneous tissues superficial to the extensor tendon.

The hand was splinted in extension and the patient left the hospital 4 days after operation. Healing was delayed by a superficial wound infection but was complete 24 days after operation. The result 11 months after operation on the right hand is shown in Figure 21 d e f. At that time the patient stated that his only disability was the inability to flex the ring finger completely. The left hand has not yet been operated upon.

CASE 23 (W M H 136603) male 47 years superintendent for street railway company. Fifteen years before admission he noticed a nodule appearing just distal to the intersection of the distal flexion crease of the palm with the pretentious band of the right fifth finger. Five years later a median cord appeared over the proximal phalanx and flexion began at the metacarpophalangeal joint. In 10 years flexion increased until extension was limited to an angle of 95 degrees. In the 5 years preceding admission other nodules appeared on both sides and in the middle of the palmar surface of the proximal phalanx of the fifth finger and in the pretentious band of the ring finger (Fig 19 a b).

The patient gave no history of trauma. He had had a gonorrheal infection some years before and a tooth extracted because of infection 3 years before.

His mother had a similar contraction of both hands, in one hand it was severe, in the other less so. The fifth finger of one hand was flexed into the palm and the ring finger to an angle of 120 degrees. The patient's maternal grandfather had a similar contraction of the right hand with the ring and little fingers flexed into the palm and a maternal aunt had a bilateral contraction more marked on the right side with involvement of the ring and little fingers.

February 6, 1928 under local anesthesia through a longitudinal incision parallel with the contracting cord the palmar fascia was widely excised.

The patient left the hospital 4 days after operation. The wound healed by primary union. The condition and function of the hand before operation and 9 months after operation are shown in Figure 19.

CASE 24 (W M H 136599) male 48 years physician. Twelve years before admission he first noted a nodule on the palmar aspect of the proximal interphalangeal joint of the right fifth finger. Six years later a second nodule appeared a half inch proximal to the first. Three years later a nodule appeared in the palm at the intersection of the pretentious band of the fifth finger with the distal flexion crease of the palm. At the same time he noticed beginning flexion at the metacarpophalangeal joint of the fifth finger.

Two years before admission he noticed the appearance of slender cords over the palmar surface of the left index and fifth fingers opposite the proximal interphalangeal joints (Fig 44).

He ascribed the beginning of the trouble to striking his palm repeatedly against the emergency brake of his car which was released by pressing downward on a knob about the size of the end of his thumb. Ten years after the onset of the trouble a bruise of the right hand sustained in raising a boat seemed to aggravate the condition. A month later the palmar nodule was removed. An infection developed after operation and persisted for about 2 weeks. After healing occurred the contraction became progressively worse.

The patient gave a history of chronic tonsillar infection and of chronic ethmoidal sinusitis of 10 year duration. Two years before the symptoms of Dupuytren's contraction appeared his tonsils were removed and all his teeth extracted.

His paternal grandfather had a contraction of both hands of many years duration. The fourth and fifth fingers of each hand were completely flexed into the palms but the distal interphalangeal joints were not affected.

February 6, 1928, under local anesthesia the involved palmar skin in the line of the fifth finger and the contracted fascia of the finger and palm were widely excised leaving a rather wide L shaped defect when the finger was extended. A free full thickness graft from the right thigh was sutured over the defect. Because of a blood clot under the proximal portion of the graft a portion of it about the size of a 25 cent piece became necrotic but healing of the raw surface took place rather rapidly by ingrowth of epithelium from the adjacent edges.

A few weeks after his discharge from the hospital 11 days after operation the patient developed an interdigital infection and shortly after returned to his home in California.

Eleven months after operation he wrote: "The hand has been very stiff until two weeks ago but it is beginning to loosen up."

Had we been able to keep closely in touch with the patient during the later postoperative period and had physical therapy been wisely applied we believe that much of the delay in the restoration of function might have been avoided.

CASE 25 (W. M. H. 136816) male 53 years, civil engineer. Twenty four years before admission he noticed a nodule between the distal and middle flexion creases of the left palm in the line of the pretendinous band of the middle finger. This gradually became more pronounced until a taut cord developed which did not, however, produce flexion of the finger.

Twenty three years before admission a similar nodule developed in the right palm at the intersection of the distal flexion crease and the pretendinous band of the ring finger. Eighteen years later a taut cord developed in the line of the ring finger which extended from an inch above the wrist to the proximal interphalangeal joint. Three years later flexion began and continued until some 6 months before admission when it seemed to become stationary.

The patient ascribed the development of the condition to holding the bridle reins with a tight grip while horseback riding and straining the cords of his hands during frequent youthful demonstrations of his powerful grip. Two years before admission he bruised his hands while playing baseball after which the flexion contraction seemed to be accelerated.

He stated that he had suffered from nasal catarrh since early youth.

His father and brother suffered from a similar contraction. Two fingers of one of his father's hands were flexed half way into the palm and the middle and ring fingers of his brother's left hand were similarly involved.

The condition of the patient's right hand before operation is shown in Figure 15 a & b. The condition of the patient's feet in both of which there was a firm thick subcutaneous cord with definite nodules along the medial border of the foot is shown in Figure 15 f.

February 20, 1928, under local anesthesia through an elongated S shaped incision along the line of the ring finger from the level of the outstretched thumb to the middle of the middle phalanx the palmar fascia was widely excised. The patient left the hospital 3 days after operation. On the radial side of the incision at the base of the ring finger a narrow elongated area of superficial necrosis developed with subsequent sloughing of the skin. This area was completely healed 2 months after operation but as a result of the scar tissue at this point there is some limitation of abduction of the ring finger.

The result 9 months after operation is shown in Figure 15 c & d. There is still a definite palmar nodule over the pretendinous band to the ring finger but it does not interfere with the function of the hand.

CASE 26 (W. M. H. 138120) female 44 years. Seven years before admission the patient cut the palmar surface of the left ring finger. Two years later a nodule appeared over the ulnar side of the palmar surface of the proximal end of the middle phalanx. Some time later flexion began and she became aware of a fibrous cord extending proximally to the web of the fingers (Fig. 15).

There was no history of past infection or of similar trouble in other members of the family.

On May 9, 1928, under local anesthesia the digital fascia of the ring finger over the two proximal phalanges was carefully excised. The patient left the hospital 2 days after operation. The wound healed by primary union and when the patient was last seen the finger could be completely extended without difficulty.

This case is the only one in our series in which the pathological process began in and remained confined to the fingers.

CASE 27 (W. M. H. 138212) male 53 years, physician. Ten years before admission he noticed a contraction of the skin of the palm of the left hand in the line of the fifth finger with beginning flexion.

of the finger at the metacarpophalangeal joint. A little later the ring finger became involved. A year later a similar condition appeared in the right hand. The contraction developed very slowly until 6 months before admission when the contraction of the left fifth finger began to increase rather rapidly.

The condition of the hands before operation is shown in Figure 18 a b f g.

The patient gave no history of trauma or of infection other than an osteomyelitis of the left arm at 8 years of age.

On May 11, 1918, under local anesthesia an ellipse of hard cornified skin and subcutaneous tissue was excised from the left hand and the fascia on either side was dissected out as completely as possible. The defect left in the palm was filled with a free full thickness graft of skin from the inner aspect of the left thigh. The nodule seen in Figure 18 a in line with the outstretched thumb was not excised because of the time consumed in caring for the major disability.

A part of the graft became necrotic but epithelialization took place fairly rapidly from the wound edges and the margins of that part of the graft which survived.

On June 4, 1918, under local anesthesia the contracted fascia of the right hand was excised through a transverse incision and the wound closed without the aid of a graft. Some serum accumulated under the flaps and caused a serous wound discharge and cellular infiltration developed in the involved area but healing took place without infection.

October 5, 1918, the patient wrote: "I have had and am still having some trouble with the left hand the one with the skin graft cracking along the line of union between the skin and the graft. I thought it would be all right as it hadn't bothered for several weeks but a few days ago another break showed. There is still some thickened skin on this hand and I suppose that when it disappears there will be no further trouble. The sensation in this hand seems about normal except at the inner side of the graft. The finger stays straight and I am able to use it without any particular trouble."

I had quite a time getting the right hand healed up. For about a month after I returned home it kept opening near the center of the incision; it would heal for a few days fill up with serum and open again. The last time it opened about one third of the way between the incision and the base of the thumb. After this I put pressure on it with sea sponges and it finally closed. It has been all right now for over 2 months.

There is still a little infiltration in the palm of the right hand but the sensation in the palm has never returned to normal. As near as I can describe it there seems to be a superficial lack of sensation or numbness and a deep hyperesthesia. In driving the car I have to wear a heavy pad in my palm; any pressure in the palm even with a blunt instrument such as a table knife feels as though I were cutting my hand. I often look at it thinking I am holding

the wrong end of the knife. I don't think there has been any change in sensation for the last 3 or 4 weeks. When I put my hand in hot water there is no sensation of heat in the palm although I almost scald my fingers. I am able to use my hands well; my fingers are straight and I am able to make a good fist but still find my fingers a little clumsy.

December 20, 1918, the patient stated that the sensory symptoms complained of were definitely less marked and that he was able to use his hands more efficiently at his work as a nose and throat surgeon.

The appearance of the hands and range of motion of the fingers December 30, 1918, is shown in Figure 19.

CASE 28 (W. M. H. 140735). Male, 53 years, dentist. Two years before his admission to the hospital the patient sustained an injury of the right palm from an automobile crank. There was a slight abrasion over the area subsequently involved in the contraction. Two months later he again sustained a slight injury of the same area from a screw driver. Four months later he first noticed a hard tender lump under the palmar skin just proximal to the metacarpophalangeal joint of the ring finger. As the process progressed a firm thick cord developed which gradually drew the ring finger down to an angle of 160 degrees at the metacarpophalangeal joint. No other fingers were involved.

The patient had had appendicitis in 1915 and influenza in 1918. He had had a mild chronic pharyngitis for some years. No other members of his family had ever suffered from a similar condition.

October 3, 1918, under local anesthesia the superficial fibrous cord was excised; the skin at either side elevated and the palmar aponeurosis excised as completely as possible. The wound healed by primary union. The patient left the hospital 6 days after operation and because he felt he must return to his home in Iowa as quickly as possible no postoperative physical therapy was given. November 28, 1918, he wrote: "The swelling has almost entirely left the hand up to the fingers but there is still considerable swelling in the fingers and stiffness in the fingers and palm. The hand is also still partially anesthetic."

December 16, 1918, he wrote: "I have just begun to use my hand the last week. The fingers are still swollen and the joints stiff. I have been wondering if radical manipulation of the fingers would cause more inflammation or aid in the recovery."

Needless to say we advised him that radical manipulation would do harm but that every form of passive and active movement that could be accomplished without causing more than slight pain would aid in the restoration of function.

This case again pointedly illustrates the fact that without carefully directed postoperative physical therapy the patient is definitely handicapped in securing restoration of function in the shortest possible period of time.

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PRIMARY CARCINOMA OF THE LUNG¹

BYRL R. KIRKLIN, M.D., ROCHESTER, MINNESOTA

S. C. R. T. G. I. S. M. C. I.

RALSTON PATERSON, M.C., M.D., F.R.C.S. (LOND.), D.M.R.E. (CAMP), ROCHESTER, MINNESOTA

F. H. W. R. T. I. T. H. M. Y. I. G. D. I. O.

AND

PORTER P. VINSON, M.D., ROCHESTER, MINNESOTA

D. V. S. O. L. M. I. M. S. C. I.

WITH the increasing accuracy of modern diagnostic methods carcinoma of the lung is being recognized more frequently. Literature on the subject deals more with the pathological and roentgenological aspects than with the clinical and an analysis of published data leaves the feeling that the bulk of the work concerns the late type of case that which is ultimately proved by necropsy. In this article an attempt is made to segregate a group of early cases from among those observed in the Mayo Clinic since 1913 and in which the diagnosis was strongly substantiated in more than half the cases the clinical diagnosis was confirmed microscopically.

Adler in 1911 reviewed all the previously ill assorted literature on primary carcinoma of the lungs, and published an excellent monograph in which 374 cases were tabulated. Few data of value have been added since except from the roentgenological point of view. Recently Fried published a critical analysis of 10 cases. Eloesser of 27 cases and Grove and Kramer an exhaustive pathological study of 24 cases. Many other writers have published smaller groups of cases but almost invariably on necropsy data. Eloesser brings out but does not emphasize a division into two groups bronchial and parenchymal. The cases in this series are divided into three groups bronchial parenchymal and late (Table I).

Group 1. The bronchial 'proved' cases consisted of those in which the lesion was demonstrated by bronchoscopy and proved by microscopic section taken through the bronchoscope. In the probable cases of this group either the lesion as seen through the bronchoscope was typical or metastasis was found with a bronchial lesion as the only primary focus discoverable.

Group 2. In the parenchymal proved cases lesions were demonstrated in the lungs roentgenologically and carcinomatous nodes were found in the neck although there was no clinical evidence of abdominal malignancy. These data although not absolute proof are strongly suggestive of pulmonary malignancy. The probable cases comprise those in which the history and roentgenograms indicate malignancy and in most of which it was ascertained that death occurred within a reasonable time after this provisional diagnosis had been made.

Group 3. In the late proved cases whether apparently bronchial or parenchymal the diagnosis was made at necropsy and in the probable cases there was clinical evidence of malignancy repeated tapping was carried out for extensive pleural effusion and the fluid withdrawn was of the sanguineous type commonly associated with malignancy of the lung.

The manner in which the early proved cases fell into two groups according to the site of the section for biopsy brings out a point that should be emphasized namely that there are in the early stage two distinct types of carcinoma of the lung the bronchial and the parenchymal. The clinical data fall into like groupings a point apparently not hitherto realized.

As seems usual in the discussion of carcinomatous lesions the etiology has received considerable attention. Many factors have been discussed varying from the perennial hypothesis of chronic irritation to the possibility of inhalation of dust from tarred roads. In influenza has been suggested as accountable for the apparent increase in malignancy of the lung. Of the 68 patients in this series 20 gave a history of previous influenza or acute respiratory disease other than tuberculosis and none

of known tuberculo. While the incidence of influenza is not low it is probably not higher than that of the disease in general considering the universality of the recent pandemics.

The ratio incidence in male and female is 5 to 1, our data thus agree in general with those of other reported groups of cases. Certain persons support the hypothesis of chronic irritation on the basis of this preponderance of males. The age incidence is much as usual (Table II).

The history of the duration of the disease and survival of patients after diagnosis is made illustrated in Table III which shows that the disease is usually a rapid process.

PATHOLOGY

Macroscopic lesions are seen only at necropsy and then only in the late stage so that the primary lesion is often more or less obscured (generalized lymphatic or systemic metastasis, a thick dense empyema like pleura or extensive pneumonitis was present at necropsy in all of the late proved cases of this series). A generally accepted gross pathological subdivision of lesions is somewhat as follows: (1) nodular (single multiple) (2) lobar or diffuse (3) infiltrating and (4) miliary.

The nodular and lobar types (reasoning from the roentgenological picture of the early parenchymal group) are merely different stages of one type. The best example of the true nodular type may be seen in Figure 1 which shows how the typical round nodule of the roentgenogram is produced.

The infiltrating type include all bronchial tumors and certain parenchymal tumors the foci of origin of which being near the hilum invade it relatively early. Figure 2 shows the gross appearance of an advanced case of bronchial tumor.

The so called multiple nodular and the miliary types are probably entirely metastatic and not actual type of primary lesion.

In order to group the microscopic data an attempt was made in the necropsy case to determine the original focus. Five of the ten cases were apparently bronchial in origin all of these five showed emphatically the frequency of metastasis distal to the lesion a point also noted roentgenologically.

TABLE I—GROUPS

| Type | Pro-
bably | Probable | Total |
|----------------|---------------|----------|-------|
| Benign | 13 | — | 3 |
| Paraneoplastic | 10 | 12 | 2 |
| Late | 10 | 13 | 3 |
| Total | 33 | 3 | 68 |

TABLE II—AGE INCIDENCE

| Age | Benign | Paraneoplastic | Late |
|-------------|--------|----------------|------|
| Under 3 | 2 | 1 | — |
| 3 to 39 | 4 | 2 | 3 |
| 40 to 49 | 6 | 7 | 11 |
| 50 to 59 | 7 | 8 | 6 |
| 60 to 69 | 4 | 4 | — |
| 70 and over | — | — | 1 |

TABLE III—DURATION OF DISEASE

| Duration | Benign | Paraneoplastic | Late | Total |
|---------------------|--------|----------------|------|-------|
| Less than 3 | 6 | 4 | 3 | 13 |
| 3 to 6 months | 6 | 5 | 5 | 16 |
| 6 to 12 months | 6 | 9 | 8 | 23 |
| More than 12 months | 5 | 4 | 7 | 16 |
| Total | 23 | 22 | 23 | 68 |

Early called attention to three foci of origin: (1) bronchial epithelium (bronchogenic) (2) bronchial mucous gland (bronchiogenic) and (3) flat epithelium of lung, alveoli (alveolar). Although this grouping is quoted in the literature almost consistently actually it is extremely difficult to correlate the cell grouping as found to the particular foci.

Grove and Kramer and later Hootner stressed a classification according to cell type. In Table III is given such an analysis of the type of tumor found in each of the microscopically proved groups. In so far as the number of cases is sufficient to justify tenable deductions it would appear that while any type of tumor may be found in the bronchus the parenchymal tumor is either an adenocarcinoma or of the highly undifferentiated type and rarely an epithelioma. The epithelioma seem to be almost entirely confined to the bronchus.

Adenocarcinoma has no characteristics peculiar to the lung. The tumor is of a simple glandular type resembling a mammary or



Fig. 1. Irregular nodular area of parenchymal carcinoma in lower lobe of lung (microscopically adenocarcinoma)



Fig. 2. Advanced carcinoma of the bronchus just below the bifurcation (microscopically epithelioma)

prostatic tumor (Fig. 3). Among the adenocarcinomas were two of a markedly papillary type forming a peculiarly distinct subgroup the significance of which we do not know. There was no indication that they were metastatic from the thyroid or the ovary although they resembled the typical papillary tumors of those organs.

The undifferentiated type was formerly called medullary and as such was noted by Adler as a common type of tumor of the lung. It may sometimes be so highly cellular as to resemble sarcoma (Fig. 4). In the absence of differentiation it is difficult to classify this tumor as either adenomatous or squamous; it might truly be called carcinoma highly malignant.

The squamous cell tumor (Fig. 5) is anomalous

in that it appears where there is no squamous epithelium. Various hypotheses are advanced to explain this. It has been suggested that the tumor originates in scar tissue but it is generally believed that it arises from true metaplasia with reversion to a fetal type of cell. The respiratory tree it will be remembered arises from a diverticulum of the foregut in common with the esophagus; a squamous cell lined canal.

Broders in his gradation of tumors according to what might be called the virulence of the type of cell shows that the less the differentiation in the cell type the more the virulence of the growth. We graded our sections according to Broders' scheme (Table IV). The

TABLE IV—HISTOLOGY

| | C f m l g r d y | | | | B h l | | P b m l | |
|----------------------------|-----------------|---|---|----|----------------|-------|--------------------|-------|
| | | | 3 | 4 | B h p
l p y | N p y | C l d f
k b p y | N p y |
| Squamous cell epithelioma | | 1 | 3 | 6 | 6 | | | |
| Adenocarcinoma | 1 | 1 | 3 | 7 | 4 | 1 | 6 | 1 |
| Undifferentiated carcinoma | | | | 11 | 3 | 2 | | 4 |
| Total | 1 | 2 | 6 | 24 | 13 | 5 | 10 | 5 |



Fig. 4. Highly undifferentiated carcinoma from a carcinoma of the bronchus (X120).



Fig. 5. Squamous cell epithelioma from a carcinoma of the bronchus (X60).

The roentgenological picture in the late stage of carcinoma of the lung varies. More than half the cases show only fluid, one lung field being solidly dense up to the apex and with the heart displaced to the other side. Again any of the protein forms of infection may be manifested secondarily. Rarely there are large tumors not concealed by fluid. One of our cases presented the picture of pure multibacillary pneumonia of the mediastinum due to lymphatic involvement from carcinoma of the bronchus, but the lung fields were not affected from such a picture lymphoblastoma would inevitably be diagnosed.

CLINICAL CONSIDERATIONS

The dominant symptoms of carcinoma of the lung are generally given as pain, cough, sputum, hemoptysis, loss of weight and dyspnea, but a really typical syndrome has not been described. If however we consider that in the early state there are two separate entities the clinical picture of each becomes much more constant. The various symptoms in degrees of severity have been tabulated separately for each group (Table VI).

In the bronchial group cough is the key symptom. While not necessarily severe or even unduly troublesome it has one definite

characteristic persistency. Sputum is seldom profuse and never foul until late in the course of the disease. It often contains blood either frank hemoptysis or more often is constantly blood tinged. Considerable loss of weight is relatively constant. Pain is usually present but seems to be less complained of than the cough. Dyspnea occurs but generally indicates some pleural effusion. Physical examination usually indicates the presence of bronchostenosis.

There is one almost certain means of diagnosis in these cases, the use of the bronchoscope. This however is worse than valueless in the hands of the inexperienced. While some ulcerations appear malignant others show merely a red granulating bleeding surface which is identified only by microscopic examination of the biopsy section.

In summarizing it may be said that in an elderly patient a peculiarly persistent cough associated with scant but usually blood stained sputum and with considerable loss of weight suggests bronchial malignancy.

The symptoms of the parenchymal group are not so clear cut (Table VI). The tabulated data however fail to bring out a point realized only by the individual study of cases, namely the marked degree of latency. In



F Prim ryl b m fth l B p f
r lymph odes h wed epith l m

give no evidence of its presence. Localized tenderness is the most constant sign, often without much apparent cachexia or symptomatic loss of strength. Pain is the most constant of the symptoms and it has certain peculiar characteristics. It is vague in the chest difficult to localize, never sharp, seldom intermittent, sometimes subterminal but more often posterior in the scapular region or even described as right inside. Mild at first it becomes gradually more severe. This characteristic type of pain is not the same as that felt later when the chest becomes full of fluid or that produced by cough and this early pain is likely to be masked later by the dominance of other symptoms. We found it usually associated with and apparently related to the nodular type of lesion. Cough relates to one of two processes, involvement of the pleura as evidenced by fluid or more often invasion of a bronchus. As with the bronchial type it may produce blood. At this stage the lesion may be demonstrable through a bronchoscope but more often the bronchus is bulged inward without actual ulceration of the mucous membrane. Dyspnea is infrequent and practically always indicates an appreciable accumulation of fluid.

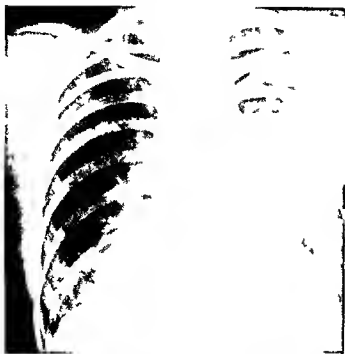


Fig. 8 Massive parenchymal carcinoma of lung. Generalized metastasis was found at necropsy.



Fig. 9 Nodular tumor with smaller metastatic areas in the apex peripheral to it. No other primary tumor was found.

Another sign is of value the presence of metastasis in the supraclavicular nodes. This occurs with such extraordinary frequency that we have used it as evidence to isolate our group of proved early cases. Physical examination is inconclusive and often negative.

The disease tends to a rapid course and does not long remain an uncomplicated malignant lesion. With extension the two types fuse to a common type which we have classified as late cases. In this group symptoms were dependent chiefly on the dominant secondary complication; their tabulation (Table VI) affords a contrast with their incidence in the other two groups. The cough blood syndrome and the pain are still present but the most prominent feature in this group is the extent of the dyspnea which can be almost constantly related to the presence of fluid.

Pleural effusion is the most common method of extension. In the entire group of 68 cases early and late there was evidence of fluid in 3. This was of the malignant type that is thin blood stained fluid which rapidly reaccumulates after tapping and the presence of which is easily recognized clinically and roentgenologically. In all of the probable late cases roentgenograms showed the entire

lung completely dense from base to apex. Simple effusions due to root lymphatic obstruction and infective effusions do occur but rarely.

Infective processes follow either necrosis in the center of a parenchymal tumor or stasis consequent on bronchial stenosis. This will so complicate the picture both roentgenologically and clinically as to render the diagnosis of other than the infective process impossible except when there are demonstrable nodes or bronchoscopy is performed.

Metastatic extension is the other common end stage. The early incidence of cervical gland involvement has been noted. In a discussion of the roentgenographic features a case of advanced mediastinal metastasis was cited. A notable feature is the frequency of metastasis to the brain as the first evidence of a lesion; in others it is the terminal phase. In this series there were 6 cases of metastasis to the brain; this feature was also noted by Parker. Another interesting evidence of extension was recurrent laryngeal involvement in seven cases.

DIFFERENTIAL DIAGNOSIS

An exhaustive discussion of differential diagnosis would enumerate practically every known lesion of the lung. The two main dis-



FIG. 1. Roentgenogram of the chest showing a large, irregular, peripheral lesion in the upper lung field, suggestive of tuberculosis or malignancy.



FIG. 2. Roentgenogram of the chest showing a large, irregular, peripheral lesion in the lower lung field, suggestive of tuberculosis or malignancy.

to be differentiated are tuberculosis which is likely to be confusing from the clinical standpoint and infective conditions which are often mistaken from the roentgenographic standpoint. Tuberculosis is important in that many patients afflicted with pulmonary malignancy waste time, hope, and money in sanatorium treatment. In such cases the roentgenogram is the chief diagnostic medium. A tuberculous lesion tends to apical distribution and malignancy to the middle region. Tuberculosis is an irregular peripheral lesion with no distinct center while malignancy, whether parenchymal or in the hilum, has an obvious center and radiate. Clinically the history of longer putum is more abundant and sometime the presence of tuberculous bacilli in the putum make the diagnosis certain. The roentgenographic differentiation of malignant from infective condition (abscess, bronchiectasis, and old lesions of pneumonia) on the other hand is by no means easy, but the clinical features are not similar. With infective condition there are periods of acute exacerbation and often putum is abundant. The sputum is also often a helpful factor. In this connection the incidence of leucocytes in the malignant cases was tabulated. Of the 41 cases in the early group, only 10 showed a

leucocyte count of more than 10,000 and in 1/4 of the entire patients actually had fever from infective complication. If the two factors could be safely eliminated but few others would remain which the correlation of clinical with roentgenographic data would not easily distinguish.

In the bronchial group the bronchoscopy is the final court of appeal. In the parenchymal group unfortunately observation is the only ultimate means of making a diagnosis. Cystic growth or cervical metastasis will confirm a suspected diagnosis of malignancy. In the late group there is seldom any doubt.

SUMMARY

In the early stage carcinoma of the lung may be divided into two types with clinical and roentgenological entities: (1) bronchial arising in the wall of a first to third degree bronchus and (2) parenchymal arising in the substance of the lung.

In the bronchial type there is a history of early chronic persistent cough not greatly productive but often associated with hemoptysis or blood-tinged putum. Usually there is loss of weight. Unilateral infiltration in



FIG. 1. Commencing atelectasis of the whole lung caused by a bronchial tumor seen on bronchoscopic examination to be occluding the left main bronchus



FIG. 13. Appearance resembling that of bronchiectasis without any clinical evidence of such caused by a bronchial carcinoma (epithelioma) of the lower lobe bronchus

sity at the hilum is seen in the roentgenogram in some cases but more constantly atelectasis of a lobe due to bronchial obstruction is seen.

The parenchymal tumor is more latent but there is definite loss of weight and a peculiarly ill localized type of pain in the chest. Later the bronchus may become invaded in which case the lesion resembles the bronchial group. In the roentgenogram it is seen as a round nodule with infiltrating edges and lying free in lung tissue. Later it involves the whole or most of a lobe.

In the later stages the two types tend to a common type and the actual malignancy is obscured either by pleural effusion or by infective processes. This is associated with dyspnea or the usual evidences of infection.

Pathologically our analysis seems to show that the parenchymal tumor is usually an adenocarcinoma that the bronchial tumor may be either adenocarcinoma or epithelioma the epitheliomata being practically confined

to the bronchus and that the lesion is of a high grade of malignancy.

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TABLE I—RESULTS

| No. | Sex | Operation | Side | Result | Age | Period | Del. | Young | |
|-----|-----|-----------|------|--------|-------|--------|-------|--------|---------------|
| 5 | 6 | 5 | Both | | Pos | 7-28 | Pos | 6-3-28 | Tw |
| 9 | 6 | 5 | Both | 5 5 5 | | | | | |
| 5 | 3 | 5 | Left | | Pos | 5 | Pos | 6-3-3 | Abor-
tion |
| | 5 | 3 | 8 | B h | | Pos | 7-0-3 | Tw | |
| 09A | 5 | 3 | 3 | B h | | Pos | 7-3-3 | On | |
| 0 | 5 | 3 | 5 | Both | 5 9-3 | | | | |
| 19 | 5 | 3 | 5 | Left | 5 3 3 | | | | |

g All h op t d g

insemination and also were definitely pregnant according to the vaginal curettage test and palpation it was feared that abortion might cause the loss of actual evidence. Therefore we decided to expose the uterus in each case and see what it held.

No 1033 was operated on May 1 1928 and the right uterine cornu exposed. One fetus was discovered. This animal gave birth on June 3rd to two young (Fig. 1) one agouti like herself and one black white and red. It is probable that one young came from the left cornu and had a different father as two males furnished the sperm for the insemination. On the other hand there may have been two fetuses on the right side and the cornu not pulled out far enough at the operation to show both.

When No 103, was inseminated the right ovary could not be located and sperm was placed only on the left side where fortunately three ripe follicles were seen. At operation three fetuses were discovered in the left uterine horn. The incision was rather small and some difficulty was experienced in replacing the enlarged uterus in the abdominal cavity. No doubt the young were injured as the mother aborted six days later.

It is interesting to note that No 1009A was only 3¹ months old at the time of operation and that she was inseminated at her fourth estrus. She is still a very small animal compared with most of the others used.

The incidence of successful impregnation omitting No 1026 which was operated on in



Fig. 1. A male 133 and female 103 off p the first embryo by the method.

the third stage (that is after ovulation) 166 per cent. This compares very favorably with natural insemination which probably does not exceed 90 per cent.

It is worthy of note that we tried this method in white rats in more than twice as many cases as in guinea pig and got no positive results. The rat has a complete bursa ovarica which separates the ovary entirely from the peritoneal cavity (4). Rupturing this sac always caused considerable hemorrhage. Injection of sperm into the bursa from a small tuberculin syringe with a fine needle or from a capillary pipette with a rubber bulb was not successful. Moreover in rats the sperm was not usually soft milky and free flowing as in the guinea pig but appeared inclined to a more solid lumpy consistency.

DISCUSSION

Whether these findings have any clinical significance is problematical. If human sperm could be obtained in aseptic condition and the exact time of ovulation foretold in woman it is probable that successful impregnation could be accomplished by this method in some cases where laparotomy was necessary for some other purpose.

This method opens an avenue of investigation into the behavior of spermatozoa in relation to the ovum and to the uterine tube. While the only animal we tried to inseminate in stage 3 did not become pregnant the same

is true of two others in stage 1. By inseminating a sufficient number of animals in stage 3 one two or three days after it starts possibly some pregnancies would occur. Since the ova require about 4 days to reach the uterus and are in the tube during this interval successful insemination would mean that spermatozoa went down the tube instead of coming up as they usually do. This might be held to prove an ovotropic influence in the mammalian ovum. It is significant that spermatozoa in the guinea pig can reach the bursa ovarica and teem in large numbers around the ovary in less than 2 hours after copulation, whereas it requires 4 days for the combined ciliary motion and peristaltic movements of the tube to carry the much larger ovum less than the distance traversed by the male germ cells. If the extremely small spermatozoa depended upon reverse peristalsis for their progress through the tube as has been claimed how long would it take for them to reach the ovary?

It is worthy of note that all the young born in this series went longer than the usual term by 2 or 3 days viz 68 days in one case and 69 in two. Whether the effects of the operation cause a delay in the early progress of the ovum we cannot say.

Whether it may be possible by this method to produce hybrids between animals that will not or can not naturally copulate will have to be determined.

A careful search of the literature does not reveal any work similar to this with one

exception (1). Kampmeier injected spermatozoa of the dog into graafian follicles of the bitch but his purpose was not the same as ours as he was making a study of early changes in the ovum.

SUMMARY AND CONCLUSIONS

1 Artificial insemination by way of the ovarian bursa in the guinea pig can be accomplished in about two thirds of the trials if the females are selected during the first stage of oestrus and a suitable technique is employed.

2 The young born are normal in every way and thrive just as the progeny of natural insemination.

3 It is possible by this method to produce young born at the same time from one mother but with different fathers.

4 This method opens up a new pathway of investigation into the behavior of the spermatozoa in relation to the ovum and to the uterine tube.

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MALIGNANT AND SEMI-MALIGNANT TUMORS OF THE OVARY

HOWARD C. TAYLOR, JR., M.D., NEW YORK CITY
F. M. H. Gynec. & G. I. N. (F. R. N. I. H. P. I.)

FOR the study of the malignant tumors of the ovary the pathological reports of the Gynecological Division of the Roosevelt Hospital were reviewed from the beginning of the year 1910 until the end of 1917 and all cases with the diagnosis of papillary cystadenoma, primary carcinoma of any variety and sarcoma were selected and the pathological sections re-examined as far as possible. That each of these varieties should be included in the complete survey was necessary because of the extreme variation in interpretation placed upon these terms by various surgeons and pathologists. Tumors considered by the operator or pathologist as being probably metastatic in the ovary have been omitted although it is possible that a few such secondary tumors have slipped into the series since the exact localization of the primary focus in the more advanced cases is often very difficult.

The total number of cases originally included was 152 of which 13 were entirely without biopsy or had been diagnosed from cell obtained by centrifugalization of ascetic fluid the diagnosis therefore being open to question. The 6 cases were excluded.

Of the remaining 139 with complete pathological reports the sections of 17 had subsequently been lost and were therefore incapable of standardization. These cases have not been used except in the final summary of end results since their finer histological characteristics are in doubt.

That a detailed pathological description is essential to any clinical report of the end results in ovarian tumors was most conclusively demonstrated to us in the study of the heterogeneous group of cases that had been ascribed to the papillary cystadenomata. In general the tendency in earlier years had been to include practically all carcinomata except the glandular and solid varieties in the papillary adenoma group. In the later years on the other hand the carcinomata appear to have been more logically placed while many tiny

tumors of a faintly papillary form but of a more adenobromatous histology had been added to the papillary cystadenomata. That clinical reports of such heterogeneous material is useless is self-evident and we are therefore reporting results on numerous small groups and later summarizing as far as consistency permits.

CLASSIFICATION

The origin of the cells that form the ovarian tumors has been a disputed point since the first studies in cellular pathology. All observable epithelial structure found in the adult ovary in the ovary of the embryo and in neighboring embryological structures such as the müllerian and wolffian ducts have been successively held responsible. The history of the earlier research into the origin of ovarian tumors is an interesting one though based almost exclusively upon morphological studies and for the moment of little value in the understanding of present theories.

Robert Meyer (41) in 1916 in an almost classical study reviewed most of the earlier work and gave a histogenetic classification of ovarian tumors. His work followed rather closely the morphological divisions of Pfannenstiel (36) but made certain change in an attempt to emphasize genetic relationship. Meyer derived all related epithelial tumors from the germinal epithelium whether they be in the form of the surface epithelium of the adult ovary or in that of remnants of the müllerian rays or rete ovarii while to the pseudomucinous tumors he tentatively ascribed a teratomatous origin.

The probability that many if not all ovarian tumor had as their origin the surface epithelium had for some time before Meyer's article been indicated by the discovery of related epithelium on the surface of the ovary and by the tracing of cord of cell down into related cysts near the surface (de Sanctis et Malas 2, Haas 13, Walthard 77, Pfannenstiel 35). On the other hand the

belief that tissue of extra ovarian origin particularly in the form of wolffian remnants played an important part in the formation of ovarian tumors was championed by von Recklinghausen (59) and long remained a popular rival of the germinal epithelium theory but it appears now to have been eliminated by the extensive studies of Goodall (1900) in comparative embryology published in 1912 and in 1900 in which he demonstrated that the tubules of the wolffian body once thought to invade the ovary during fetal life never do so but are met outside of the ovary by tubules growing down from the ovarian cortex. The theory that pseudomucinous cysts are merely the overdevelopment of the entodermal component of a teratoma had been originally proposed by Hanau (24) in 1898 had received strong support from Ribbert (60) and had been in part accepted by Pfannenstiel (56) in the sense that he considered these tumors as arising from the follicle epithelium. It was chiefly opposed by two theories the first of which maintained that ovarian cysts were frequently derived from müllerian duct rests and the pseudomucinous varieties were showing a development in the direction of that part of the müllerian duct which forms the mucous glands of the cervical canal (Kossmann 28 29) while the second asserted that the germinal epithelium with the aid of its facility for metaplasia could be transformed even into goblet cells. The latter theory rested partly on Walthard's (77) work in which he had shown the presence of goblet cells in small islands in many otherwise normal ovaries a study supported by Lahm (32) and others but recently called in question by Richter (61). In general however it may be said that in 1920 it was a prevailing belief that ovarian tumors were all ovarian in origin the serous ciliated tumors coming directly from the germinal epithelium and the pseudomucinous from the germinal epithelium either by a short process of metaplasia or the longer one of passing through the ovum stage and being ovulogenic that is to say teratomatous in origin.

Sampson's (64) first paper in 1921 on endometrial implants in the ovary and peritoneum with its ingenious theory of their origin and

its demonstration of their surprising frequency offered an entirely new theoretical source for the origin of cells in the ovary that might produce neoplasms. Sampson's theory of transtubal implantation of endometrium is still receiving strong opposition. Halban (23) supported later by Mestitz (40) has proposed a theory of origin dependent upon a supposed transportation of endometrial material by way of the lymphatics to the ovary and other points at which endometrial implants were found. This has not however received the approval that has been accorded the serosal metaplasia theory frequently suggested in the early studies of R. Meyer (42 43) and of de Josselin de Jong (6) elaborated by Lauche (33) in 1921 and more recently discussed by Meyer (44) Robinson (62) Novak (53) Semb (50) and others by which it is believed that various areas of the peritoneum have retained the ability under certain circumstances to form structures similar to the müllerian epithelium of the uterine mucosa. Whatever the origin of these structures the fact remains that endometrial tissue is of far greater frequency in the ovary than had formerly been supposed and may surely be a fertile source of tumors.

In 1924 and 1925 Sampson (65 66) developed his theory of cancer taking its origin from endometrial implants and he referred to this particular type as endometrial carcinoma of the ovary. That the commonest form of carcinoma of the ovary closely resembles carcinoma arising in the uterine fundus morphologically is obvious but whether this is because the carcinoma arises from actually transplanted uterine mucosal tissue or from the surface epithelium of the ovary which is genetically related to the uterine mucosa through their common ancestor the coelomic endothelium or finally whether in certain instances the ovarian surface epithelium passes by metaplasia through an endometrial stage before becoming carcinoma is undetermined. No one as far as we can discover has been able to separate an endometrial carcinoma morphologically from what we might call the germinal epithelium carcinoma of the ovary and though we had this in mind to do if possible while reviewing the present series we

were unable to find even the smallest indication of a practical or theoretical structural ground for such a division.

The classification which we have used therefore follows closely that of Robert Meyer (41) and Fannestiel (56) in that it separates rather definitely the serous from the pseudo-mucinous tumors. This we felt is of particular value because of the possible origin of the serous tumors from endometrial growth in the ovary. The classification is as follows:

1 *Surface epithelial tumors*. These tumors as a whole may originate from the germinal epithelium or from the heterotopic endometrial tissue. They form in all about one third of the ovarian tumors of which approximately one half show papillary growths and one half of these carcinomatous changes (Stuebler and Brandess).

2 *Pseudomucinous tumors*. These tumors may perhaps be similar in ultimate origin to the serous tumors but they offer certain differences in their etiology and pathology to justify a continuation of their separation. The frequency of pseudomucinous tumors is variously reckoned from 30.6 per cent (Stuebler and Brandess) to 53.6 per cent (Lippert) and even to one third (Fannestiel) of all ovarian new growths but of these only 6.7 per cent are said to be malignant and only 2.07 per cent of the others to produce pseudomucinous peritonitis (Stuebler and Brandess).

3 *Teratoma*. These tumors include the teratomas which make up about 10 per cent of all ovarian tumors and of which only 3 per cent are said to be malignant (Lippert, Kromer) probably the embryonic solid tumors but predominantly in young girls. Struma ovarii possibly also all of the pseudo-mucinous tumors and perhaps a good many other rare types the peculiar structure of which is due to the domination of the picture by one constituent of the teratoma.

4 *Sarcoma*. These tumors are probably extremely rare. Many of the neoplasms which formerly were diagnosed sarcoma are now considered a type of round cell carcinoma. The frequency of these neoplasms has accordingly been variously estimated to form from about one to more than 5 per cent of all ovarian tumors (Lippert 2 per cent, Fannestiel 5.38 per cent, Stuebler and Brandess 3.2 per cent, Schroeder 1.6 per cent). In the present series the relation of sarcoma to carcinoma was 2 to 86.

5 *Metastatic*. The relative frequency of all second growths of the ovaries reported by different authors has varied greatly and seems to depend chiefly upon the source of the material examined and to some extent upon the author's bias in respect to the doubtful case. Frank's work which can hardly be surpassed in its reliability which is based upon a study of operative material showed 15 per cent

of the ovarian growths to be metastatic while Le in a series of 34 postmortem examinations performed for cancer found the ovaries involved in 60 of which 58.3 per cent were metastatic.

The secondary tumors may be grouped as follows: a Tumors primary elsewhere in the genital tract. Yet when a growth is found in the ovary coincident with a carcinoma of the endometrium or endosalpinx there is often a particular difficulty in determining the actual primary site.

b Krukenberg tumors of a specific histology and as a rule primary in some part of the gastrointestinal tract.

c A considerable number of glandular medullary and diffuse carcinomata. This is not a well recognized group because of the general concentration of interest upon the Krukenberg tumor as the typical form of metastatic ovarian cancer although Frank has emphasized the frequent absence of the characteristic mucous cell in secondary growths and Stuebler and Brandess found the Krukenberg pathology in only 27 ovarian tumors that had their primary focus in the gall bladder or stomach.

6 *Racemate*. This group of tumors has recently been reviewed by Wolfe in this country and in Glyn in England and there seems to be good evidence that such types of tumors occur although they must be extremely rare.

b *Hyperepithelioma*. This type of tumor has recently been carefully studied and discussed and probably eliminated as a form of ovarian tumor by Ernest Glyn.

c *Clear epithelioma*. A type originally discussed by Pisk (57) in 1904 which has been cropped up in the form of rare case reports ever since.

d *Adenocarcinoma of the ovary*. A very interesting type upon which there is a fairly extensive literature. Recent articles have been written by Meyer (45, 46) and Neumann (48).

e *Germinal cell tumors*. These are rare tumors including a relatively benign variety known as the oophoroma folliculare (Benker) and a malignant type the follicular carcinoma (Kahlen). The tumors though frequently appear to form a definite morphological group although their relation to either ooma or follicle is much in doubt.

f *Endothelioma*. This is a much debated tumor about which I am writing somewhat by stating that critical research justifies the current skepticism. Although likewise appears dubious about the existence of this tumor, He Bors on the other hand goes so far as to distinguish a hæmangioendothelioma and a lymphangioendothelioma. There are cases in the present series that appeared to require it even suggest the diagnosis.

The classical division into solid and cystic, papillary and glandular tumor we have entirely subordinated to the classification according to the finer cellular morphology.

because we feel that these variations in topographical arrangement have a relatively minor significance often depending only on the point in the ovary of the origin of the tumor or the place in the tumor from which microscopic preparations were made. True solid tumors are extremely rare and seem as a rule to be of teratomatous or sarcomatous nature but sections that appear to have been cut from solid tumors are fairly frequent either because the section is made in a region of diffuse infiltration from an otherwise papillary tumor (Fig 12) or because from compression a papillary tumor except in particular regions may appear to be solid.

Glandular and papillary tumors are as a rule manifestations of a similar cellular process the variations in form being due to the physical condition to which the surrounding tissue subjects them and to some extent perhaps to cell function. Papillæ are in fact formed by two different methods (1) by the simple sprouting of epithelium which carries a little connective tissue and blood supply with it (see Figs 3, 6) or (2) by the formation of multiple glands which dilate until the partitions rupture the broken ends thus forming the projecting papillæ (for example see Fig 13).

The former process produces the multiple branching papillæ of the serous cysts the latter the peculiar interlacing structure of the pseudomucinous cysts. That both processes are operative to some extent in both types seems to be obvious from a study of the sections although Meyer (41) in his contribution states that the mucinous cysts are only pseudopapillary. In many tumors one finds glandular or tiny cystic spaces which are filled with intraglandular papillæ and the problem of classification on this basis becomes a still more difficult one. It should be mentioned also that a finding of a glandular carcinoma of the ovary next to the typical Krukenberg tissue should awaken more suspicion of the tumor being secondary to a growth out side of the ovary than should any other histological finding. This should be particularly the case if nowhere can any attempt at papillary formation be found within the glands.

ANALYSIS OF PRESENT SERIES

The following classification was made of the 121 cases in which microscopic sections were still available for study and which had originally been diagnosed as papillary cystadenoma, primary carcinoma and sarcoma. The first two varieties described below may perhaps not rightly belong in this series but are included to indicate the errors that may arise when papillary cysts are reported without due consideration of the exact meaning of the terms employed.

Benign Papillary Tumors

1 *Cysts that are of tubal origin* (4 cases Fig 1). In three of these cases the diagnosis of cyst was first made by the pathologist the surgeon having been under the impression that he was operating upon a case of chronic salpingitis. Microscopic sections however showed cystic spaces with small clublike papillæ growing into them with epithelium closely resembling that of the fallopian tubes and with a connective tissue as a rule of a hyaline character but in places resembling the typical ovarian stroma. It is probable that these are not true ovarian cysts but are either small areas of hydrosalpinx with regenerating epithelium adherent to the ovary or are tubo-ovarian cysts formed by the adhesion and rupture of a hydrosalpinx into a follicular cyst and a subsequent proliferation of the tubal epithelium to line the ovarian component as well.

2 *Papillary fibro adenoma* (9 cases Fig 2). This term has been employed to describe a very early type of growth that appears grossly as warty or very small papillary or cauliflower-like projections. These growths in our series occurred in cysts varying from small unilocular tumors of 3 centimeters in diameter to larger cysts of 20 centimeters and were found singly limited to one loculus of a multilocular tumor or in some cases scattered diffusely over the whole lining of a large cyst giving it a granular or sanded appearance. The fluid content is as a rule clear. The tumors are nearly always unilateral but the opposite ovary is often cystic (55 per cent). Microscopically the tumors have the form of large blunt or bulbous projections consisting chiefly of stroma. The connective tissue is occasionally hyaline but the œdema that tends to appear in the tips of the papillæ gives them a myxomatous appearance. The epithelium as a rule is flat especially in the dilated papillæ. In other regions there may be multiple layers of very fine cells and occasionally little papillary projections indicating an approach to the group of true papillary cystadenomata. Finally the papillæ may contain a few glands and muscle fibers indicating an adenomyomatous origin. These tumors have apparently no tendency toward malignancy although one of our patients developed an other tumor 8 years later probably in the opposite

ovary though this has not been proved by operation. In these cases the growths are probably to be considered as precursors of the papillary cystadenomata and are similar in their pathological status to the intracanalicular fibro adenomata of the breast.

3 Papillary cystadenomata (22 cases) These tumors are distinguished from the preceding group of the fibro adenomata by their essentially epithelial character and from the succeeding group of carcinomata by the perfect regularity of the cellular arrangement and by the uniform and fully differentiated character of the cell themselves which may however show wide variations among different tumors due to differences in the stage or type of their secretory functions and to the degree of rapidity of their proliferation (hyperplasia).

a Serous cysts (16 cases) These tumors varied from a few centimeters to 25 centimeters in diameter but the majority measured about 25 centimeters. The greater number were multilocular but the fluid content varied from clear through thick and brown to purulent. The projections were sometimes warty as in the previous variety but frequently formed large papillary masses though it must be stated that the most active proliferation was sometimes found in the smallest papillae. Sometimes only one small loculus of a very large cyst was involved in others a large cyst might be nearly filled with a papillary growth springing from a single tiny pedicle while other cysts possessed walls which were uniformly shaggy with papillae. Microscopically the papillae were multiple branching structures with little interlacing and were covered with an invariably ciliated epithelium. Two degrees of activity could rather easily be distinguished; one relatively inactive (Fig. 3) the other an extremely hyperplastic variety (Fig. 4) that gave evidence of approaching a carcinomatous condition. In the former the connective tissue was relatively abundant the papillae broad and simple in structure. The cell varied little in size or often dilated a little from contained secretion and contained a medium sized oval nucleus and only an occasional acidophilic nucleolus. The hyperplastic type on the other hand showed multiple fine branching papillae with many fine secondary offshoots and an epithelium made up of tall columnar cells very closely packed together with little or no cytostolism and slender tall dark nuclei with many striking nucleoli. The identification of these varieties is important. Of the inactive type of which there were 8 cases only one was bilateral (another had a previous unilateral oophorectomy) and there were no cases with implants on the peritoneum. One patient died of postoperative shock, 3 are alive and well over 5 years and the others are known to be well for a shorter time. Of the hyperplastic variety 3 were bilateral and each of these had implants caught rediffusely over the peritoneum or in the intestine or omentum one other had ascites and a external papilla on the surface of the cyst while a fifth had external papillae alone. In pit of this 2 of the patients have lived 14 years another 6 one

other 4 and the 3 others are alive and well less than that time.

It is this hyperplastic type of papillary cyst which is believed to be the one involved in the spectacular reports of regression of carcinomata of the ovaries following incomplete operation. It should be noted that of the 3 patients in whom the abdomen was closed after the operation undoubtedly incomplete (and who have now lived 14 years 6 years and 4 years respectively) each had not reached the menopause. If we regard this type of papillary cyst with implants upon the peritoneum as a hyperplasia of a peritoneal endometrium or of a tissue with similar functional status the explanation of the regression following castration becomes more simple. In our entire series we have no case of a true cancer showing any sign of spontaneous regression although some pathologists might classify our hyperplastic papillary cysts as carcinomata.

b Pseudomucinous tumors (6 cases) Grossly these are as a rule very large tumors although in our series the smallest was 4 centimeters in diameter and the largest 40 centimeters. They were invariably unilateral and usually multilocular though one chamber usually predominated. Although in the serous tumors the fluid was often thick and viscous it is invariably so in the pseudomucinous tumors and is as a rule described as jelly like. The papillae are small and insignificant and the papillary nature may often not be discovered until the pathological examination. Microscopically (Fig. 13) the papillae show an interlacing structure indicating their glandular origin. The epithelium has a palisade like appearance with occasional little tuftlike projections without connective tissue participation in their growth. The cells are filled with clear mucus throughout their distal thirds while the nuclei lie flattened at the bases. Cilia are never found. Of the 6 cases in this group 2 are alive and well 5 years 2 for a shorter time and 2 have been lost. There is of course no reason to expect late developments in this type beyond the remote danger of the formation of a pseudomyxoma peritonei.

The summary of the 21 cases of papillary cystadenoma of mucous and serous types is therefore as follows:

| | | | |
|--------------------|---|-----------------|---|
| Incomplete removal | 1 | Fig. 7 | 3 |
| Alive | | | 3 |
| Operated | | | 1 |
| Deaths | 1 | Current disease | 0 |
| Kept | | | |
| Lost | | | 2 |
| Alive | 5 | years | 8 |
| Alive | 3 | years | 8 |
| Alive | 3 | years | |

MALIGNANT TUMORS

The 88 remaining tumors were malignant all being carcinomata except cases which were sarcomata. In classifying these tumors we have attempted to follow the customary divi-



Fig 1 Papillae of possible tubal origin which were adjacent to the ovarian tissue simulated a cystadenoma



Fig 2 Papillary fibroadenoma. Low power. The epithelium is composed of very small cells the stroma of dense but in places of edematous fibrous tissue

sion into degrees of malignancy. This has been possible in the more common mucous and serous tumors but we have been obliged to add a miscellaneous group unclassified in regard to degree of malignancy. This group contains those tumors in which there is a question as regards the primary point of origin or which are too rare to justify any subdivisions.

Probably because in ovarian carcinoma we are dealing with adenoid and not epidermoid types we found Greenough's (1) method of classification somewhat more useful than Broders' (6, 7) although the two systems are in reality mutually complementary. The three chief points upon which the estimation of malignancy depends are as follows:

1. Loss of adult structural form which Greenough describes as the loss of the adenomatous arrangement of tumor cells around an open space and which can be translated into the pathology of our papillary tumors as the

development of a multiple or irregular arrangement of the epithelial cells in relation to the connective tissue stem of the papilla.

2. The loss of evidence of adult functional capacity, this capacity being evidenced in the ovarian neoplasms by the dilatation of the cells with mucous secretion in the pseudo-mucinous tumors and by the presence of clear areas in the cytoplasm and the presence of cilia in the serous tumors.

3. Nuclear changes by which is meant hyperchromatism, irregular and frequent mitosis and variations in form and size.

Greenough divided the tumors into high, medium and low malignancy upon a more or less general appreciation of the status of the tumors on the basis of these three factors while Broders based his classification upon the percentage of undifferentiated elements found. The latter method seemed entirely inapplicable in these ovarian tumors because all of the cells in any given section appeared to have



Fig. 1. (Left) Low magnification view of the ovary showing the glandular structures. (Right) High magnification view of the glandular structures, showing the cellular details.



Fig. 2. (Left) Low magnification view of the ovary showing the glandular structures. (Right) High magnification view of the glandular structures, showing the cellular details.

advanced to approximately the same degree of malignancy and to be entirely undifferentiable on the basis of a mathematically rated percentage of undifferentiated cells.

One particular point stressed by Broder (1931) as a sign of malignancy was the relative frequency of the "one-eyed cell" by which term he designated cell with large dark staining nucleoli. In the ovarian tumor a large pink staining nucleolus had impressed upon it a striking feature even before our discovery of Broder's description of it. This structure seemed to us, however, to have to do with rapidity of proliferation rather than with the degree of undifferentiation because it was found in many of the rapidly growing benign papillary cysts as well as in the more malignant tumor but was again a less striking finding in the extremely undifferentiated tumor of Grade III that we have some reason to believe are no less low growing than Grade II

The simplest possible system of classification of adenomatous and papillomatous tumors seem to be as follows:

Grade I—Tumor in which the adult structural form is almost universally maintained and in which malignancy is indicated only by moderate nuclear change or by occasional small areas of loss in the adult arrangement of cells in relation to lumen or basement membrane. This is the adenoma-malignum type.

Grade II—Tumor which are strikingly malignant in their loss of adult structural form but which *invariably* in one place show some glandular arrangement or its equivalent papillary form.

Grade III—Tumor in which glandular or other adult form *never* occur. Diffuse carcinoma.

This classification is based primarily upon the first criterion of malignancy, namely, anaplasia. Since the glandular arrangement is



Fig. 5. Papillary serous cystadenoma. Hyperplastic type. Low power. Multiple papillary fronds lined by high columnar epithelium. Multiple peritoneal implants and metastases. Patient alive and well after 14 years.



Fig. 6. Papillary serous cystadenocarcinoma. Low power. Malignancy. Early metastatic implants. Recent case done well.

also an index of cell function it was logical that the disappearance of intracellular evidence of adult secretory function should be found to run parallel with the disappearance of the secreting forms of cellular arrangement. The third criterion, namely nuclear irregularity, which we feel should perhaps not be considered as a sign of loss of differentiation but of some entirely new factor connected with rapidity of proliferation, did not parallel these losses of adult form and function but was more marked in our Group II than in Group III.

TABLE I—CARCINOMA—TWENTY-SIX CASES

Subgroup 1. Serous papillary carcinoma (11 cases: Figs. 6 and 7). The cysts in these cases were slightly smaller than those in the previous benign variety, averaging about 10 centimeters in diameter. In 5 cases the cysts were bilateral; in 3 unilateral; in 3 previous operations had been done and the opposite ovary removed and in 1 the condition of the other ovary was undetermined. The papillary masses as a rule nearly filled the cyst and in 2 cases had the

form of external papillomata. Four patients showed peritoneal metastasis. Microscopically there were two somewhat distinct types. One showed peritoneal papillae lined with rather regular single or double tiers of cells with oval slightly vesicular nuclei. The other in which fell the external papillomata and two small intracystic growths showed cauliflower-like clumps of papillae filled with small glandular spaces and lined with a single layer of epithelial cells with tiny round dark nuclei. In most of these tumors ciliated cells could be found with sufficient search and the oil immersion lens. In this group 3 patients died from operation, 3 from a recurrence of the disease 1/3 and 3/4 years after operation respectively. 1 patient is alive and well after 8 years, 1 for 4 years, 3 are alive and well for a period less than 3 years and 1 is lost. The patient alive for 4 years had a resection of an omental metastasis as well as a bilateral oophorectomy.

Subgroup 2. Glandular carcinoma (6 cases: Fig. 8). These tumors are of somewhat doubtful origin but may be merely a morphological variety of the serous cysts. Five of these tumors were unilateral and consisted of definite cysts averaging 15 centimeters in diameter. Of these 4 showed peritoneal implants. The papillae consisted of polypoid or



Fig. 9A. I. p. l. y. s. t. d. x. m. (d. l. l. w. d. i. n. t. l. y. m. l. x. t. h. l. o. l. t. t. l. d. f. j. y. r. s. f. t. p. t.)



Fig. 9B. I. p. l. y. s. t. d. x. m. (d. l. l. w. d. i. n. t. l. y. m. l. x. t. h. l. o. l. t. t. l. d. f. j. y. r. s. f. t. p. t.)



Fig. 9A

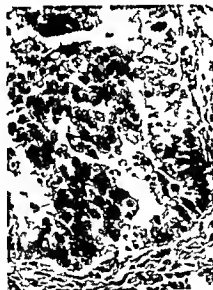


Fig. 9B

Fig. 9A. I. p. l. y. s. t. d. x. m. (d. l. l. w. d. i. n. t. l. y. m. l. x. t. h. l. o. l. t. t. l. d. f. j. y. r. s. f. t. p. t.)
 Fig. 9B. I. p. l. y. s. t. d. x. m. (d. l. l. w. d. i. n. t. l. y. m. l. x. t. h. l. o. l. t. t. l. d. f. j. y. r. s. f. t. p. t.)



Fig. 10A

Fig. 10A Papillary cystaden carcinoma Grade III Low power Small comparatively uniform cells faint attempts at papillary structure in places Patient died in 9 months

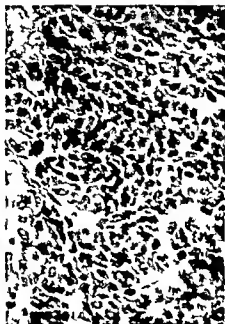


Fig. 10B

Fig. 10B Papillary cystaden carcinoma Grade III High power Small comparatively uniform cells faint attempts at papillary structure in places Patient died in 9 months

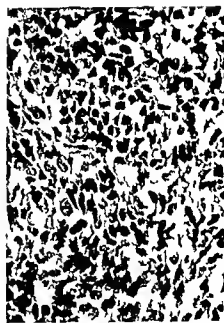


Fig. 11

Fig. 11 Papillary cystaden carcinoma Grade III High power Small relatively uniform cells No attempts at glandular or papillary formation Patient died of recurrence in 6 months

Fig. 11 Papillary cystaden carcinoma Grade III High power Small relatively uniform cells No attempts at glandular or papillary formation Patient died of recurrence in 6 months

granular masses. The tumors were usually multilocular, the fluid content being as a rule too cloudy with debris to permit identification. Microscopically the tumor consisted of immense hypertrophic glands and papillae covered with thick bands of a similar hypertrophic epithelium. This epithelium was composed of large cylindrical or oval nuclei closely packed in together uniform in size and shape but showing many mitoses and intensely stained nucleoli. Four of these cases are dead of the disease and one lost the one lost being the only one without peritoneal implantations.

The sixth case occurred in a very young woman and consisted of tiny warty cystic growths in both ovaries these tumors showing on section a small glandular carcinoma with large polygonal cells and round nuclei quite different in structure from the polypoid glandular carcinoma noted above. The patient was treated by removal of one ovary and partial resection of the other and she was alive and well 2 years after the operation when she died of an intercurrent infection.

Subgroup 3. Mucous carcinoma (5 cases Fig. 14) These were all large cysts all unilateral (except one case in which the patient had had a previous operation) all filled with a glairy or gelatinous or mucoid substance but now showing in contrast to the pseudomucinous cystadenomata definite cauliflower and fungating masses projecting into the cysts. Only one that which had been previously operated upon showed peritoneal implantation. Microscopically these tumors present the same delicate feathery

interlacing forms as the benign mucous cysts but the cells were larger and the nuclei more vesicular and small solid clumps with evidence of loss in polarity occurred in places. In some tumors the secretion of mucous had been so tremendous as to

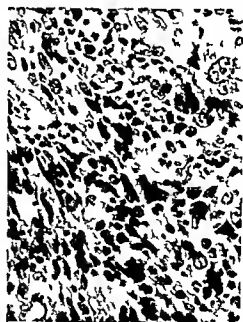


Fig. 12 Invading cell of a papillary cystaden carcinoma High power illustrating a possible error in the diagnosis of solid tumors

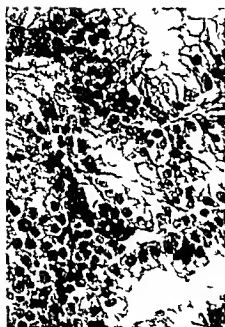


Fig. 5

Fig. 5. Mucinous cystadenocarcinoma. Crude High power. The tendency to form large nodules of cells shown latent alive with recurrence after 3 years.



Fig. 6

Fig. 6. Pseudomucinous cystadenocarcinoma. Crude High power. The papillary structure faintly suggested.



Fig. 16

Fig. 16. Follicular cancer. High power. The gland-like spaces are surrounded by multilayered cells that can also be seen invading the stroma. Patient alive and well 5 years after operation.

centimeters in diameter. In 13 patients the cysts were bilateral in 2 unilateral and in 1 the opposite ovary had previously been removed. Of the 16 cases 15 had either ascites or implants, although in two of these the implants were restricted to the uterus or tubes. Microscopically the tissue consisted of masses of cells in multiple tiers upon the papillae with only here and there a sign of orientation as indicated by the perpendicular row of basement cells or rarely as a segment of a papilla covered by a single regularly arranged row of cells. The cells themselves were large polygonal structures with plenty of cytoplasm, rather definite cell boundaries with large vesicular nuclei, granular peripheral chromatin and a large central pink staining nucleolus. One patient died from operation, 12 died of the disease on an average of 5 months after the operation, 1 had a recurrence and 2 are so far free from recurrence but have not yet reached the two year interval.

Subgroup Glandular carcinoma (6 cases). There is a definite possibility that some of these tumors described below, especially among the more advanced cases with multiple implants, may be primary elsewhere than in the ovary. The tumors were about the same size as in the papillary cysts, were bilateral in 5 cases and unilateral in one. The five bilateral cases all showed multiple peritoneal implants. Microscopically the cells were for the most part similar in morphology to those of the papillary group but were arranged in the form of glands with



Fig. 17. Periductal carcinoma. Crude Low power. Multicystic spaces lined by epithelium and connective tissue. Implants mucous carcinoma peritoneum.

| | |
|-----------------------------------|----|
| Incomplete operation | c |
| Operative deaths | 9 |
| Deaths or recurrence from disease | 1 |
| Lost | 10 |
| Alive and well 5 years | 1 |
| Alive and well 3 to 5 years | 1 |
| Alive and well under 3 years | 1 |
| Average time of death in months | 13 |

On the whole both pathologically and clinically this group seems a little less malignant than the more differentiated but also more irregularly growing carcinomata of Group II

MISCELLANEOUS

The miscellaneous group includes the following

1 Adenomatous tumors of the ovary associated with tumors arising elsewhere in the genital tract (a) carcinoma of fundus and ovary (b) carcinoma of tube and ovary (c) carcinoma of cervix and ovary

Rare epithelial tumors (a) folliculoid (b) squamous carcinoma of dermoid (c) carcinoma of cyst of Morgani

3 Krukenberg

4 Sarcoma

a *Carcinoma of fundus and ovary* Novak (54) has recently published a study of the combination of ovarian and uterine carcinoma which occurred in 7 of 147 cases of carcinoma of the fundus. In the present series combined carcinoma of ovary and fundus occurred in 5 of 86 cases of carcinoma of the ovary. It was Novak's belief that coincident carcinoma of ovary and fundus was nearly always primary in the fundus and spread to the ovary through the lymphatics which resulted in the growth appearing in the ovary as an invasion from the center outward. Sampson (65) believes in a transubal implantation on the ovarian surface of a primary fundus carcinoma. The subject has a considerable German literature which has recently been discussed by Burckhard (8). Lymphatic spread should theoretically be simpler from the uterus to the ovary than the reverse and the majority of writers seem to favor the fundus as the usual primary, although nearly all admit the possibility of either organ producing at times the original of the coincident tumors. The possibility of the spontaneous independent incidence of two tumors should not be entirely discarded. The

argument in favor of the truth of this mode of origin may be arranged as follows

1 Ovarian tumors have a predilection for early if not simultaneous involvement of both sides and this is especially true of the type that resembles uterine carcinoma. It may be argued that in bilateral ovarian growths the tumors are primary in only one ovary but the simultaneous formation of multiple papillomata over a large area of the inner surface of a cyst or in several separate loculi of the cyst can hardly be denied.

Ovarian carcinoma may arise from endometrial growths in the ovary practically identical with the uterine mucosa or if from the germinal epithelium from a genetically rather closely related structure.

3 Ovarian endometriomata are known to respond in a way similar to the uterine mucosa to the stimuli of menstruation, pregnancy and menopause. If the unknown stimulus to the production of cancer can produce multiple growths simultaneously in two ovaries it is distinctly a possibility that it may also produce similar growths in a third location of the similarly functioning tissue.

In our series of combined ovarian and fundus carcinoma the ovarian tumor was bilateral in 3 cases and unilateral in 2 cases. Contrary to Novak's findings that most of the ovaries in these cases of combined tumors were smooth relatively small firm structures all of the ovarian tumors in this series were definite papillary cysts, no case being without a cyst at least 10 centimeters in diameter and one was as large as 20 centimeters. The records on the distribution of the papillary growths in the fundus and in the cysts are unfortunately somewhat vague and the gross specimens were not available for a new study. All of the cysts were however multilocular and the papillae were internal and numerous. Apparently in all the uterine carcinomata was universal except in one case in which it was limited to one horn on the side opposite the involved ovary. Microscopically the morphology followed rather closely the structure described under Grades I and II of the serous cysts already described. In one tumor the fundus slides are lacking. In one the tumors are identical in appearance in ovary and endometrium and of the Grade I type. In the three remaining cases the ovarian growth is definitely of a more malignant type than in the other. Of these 5 cases 2 patients are dead the others are well but still under the 3 year period.

b Ca cinoma of t be and ovary (cases) This combination offers a somewhat similar problem. Our cases include only those in which there was an extensive involvement of the endometrium and does not include those with merely serosal implants. In the more recent case of the two there were large bilateral unruptured papillary ovarian cysts and both tubes were dilated to a diameter of 4 centimeters and uniformly filled with papillary material. The gross description of the other is a very old one and is not complete. Microscopically the tissue is similar to that of the ovarian carcinoma of Grade II except that the cells are perhaps somewhat smaller. One patient is dead the other lost.

c Ca cinoma of cervix and ovary (1 case) This case developed a bilateral papillary cystadenoma of the ovary 3 years after radiation of the cervix for epidermoid carcinoma. In one loculus of the papillary cyst was found what appeared to be a metastasis of a squamous carcinoma. There are a few cases reported of development of ovarian tumors after radiation (Grosse 2 Vogt 76). This case died 1 1/2 years after the operation for the cyst. Frankl (15) has reported 3 similar cases of papillary adenocarcinoma of ovary with squamous carcinoma of cervix.

R epithelial tumors of the endometrium (1 case Fig 18) This consisted of a multicystic and solid unilateral ovarian tumor in a girl of 17 years whose menstruation had always been irregular but had entirely ceased a year before the operation. Microscopically the tissue showed numerous round spaces surrounded by multiple layers of peculiar small round cells and an ovarian stroma invaded diffusely by the same type of cells. Although these tumors are rather unusual there is a very extensive list of case reports mostly in German of similar and supposedly allied types (Neumann 49 50 Blau 3 Schiffmann 69 Krompecher 31 Robinson 63). The present case is peculiar in that the majority of the others have occurred in women who are past the menopause and are accompanied by a return of the menses rather than by their cessation. The case just described is alive and well nearly 3 years postoperatively.

b Squamous carcinoma of the endometrium (1 case) In both of these cases there are unilateral dermoid cysts with hair and in each case there were peritoneal metastases. Microscopically the malignant areas showed invading masses of large undifferentiated cells with only here and there evidence of their squamous origin. Both patients died within 3 months. Neuhauer (47) reported a collection of 35 such cases (6 operable) of which only 3 could be considered cured even over a short period.

c Ca cinoma of the body of Morgagni (1 case) This is a very old case and the reports are very meager. Grossly the tumor consisted of a small cauliflower growth into the cavity of Morgagni. Microscopically the tissue consists of fibrous tissue with small clump of large round malignant cells. The ultimate fate of this patient is unknown.

3 Krukenberg tumors (cases) The peculiar structure of these tumors has attracted an immense amount of attention since their original description in 1896. The subject has been widely discussed and reviewed in this country by Stone (73) and Mayr (38) in England by Shaw (1) and in Germany by Frankl (15) and by a host of others. Histologically the tumor consists of a dense almost sarcomatous fibrous tissue invaded by mucus producing epithelial cells that have often a signet ring form due to the dilatation of cells with mucus and the compression of the nucleus. This tumor can theoretically be produced by the reaction of the ovarian stroma to a malignant invasion of mucous epithelial cells from any source. The tumors are consequently considered to be a rule secondary to a primary carcinoma of the intestinal tract or gall bladder but the existence of primary ovarian Krukenberg tumors can be explained by the diffuse growth of mucus cells from an ovarian pseudomucinous carcinoma through ovarian stroma. Neumann (51) has in fact published in great detail the report of such a case. In spite of the fact that these two cases were originally classed as ovarian growths both were almost certainly secondary one patient having had a gall bladder operation of unknown nature 2 years previously and the other showing some gastric involvement at the time of the operation. In each case there were bilateral ovarian tumors ascites and multiple peritoneal growths. The histology was quite typical although signet ring form were difficult to find in one of the cases. In both of these cases it was not possible to operate and the patients promptly died.

4 Sarcoma (case) One of these cases was a spindle cell sarcoma in the wall of an immature ovarian cyst which was not recognized at the time of the operation and recurred in the form of a similar sarcomatous cyst in the opposite ovary a year later. Although there was no evidence at the later laparotomy of extension beyond the ovary the patient died from this second operation. The other patient presented an immense solid and cystic unilateral tumor with omental and uterine nodules. The histology showed round cells in places in other regions there were cells resembling smooth muscle fibers. This patient is alive nearly 4 years since the operation but she has had signs of a recurrence for at least 2 years.

Although of little significance since they represent such a mixed group the end results for the 16 cases of the miscellaneous tumors are as follows:

| | Case |
|-------------------|------|
| I m p l e m e n t | 8 |
| O p e r a t e d | 1 |
| D e d o r u e d | 2 |
| A t l a s | 0 |
| A l l e d | 13 |
| A t d w l | 13 |
| L o s t | 4 |

TABLE I—COMPLETE SUMMARY OF RESULTS

| | N | nb | H ₁ t
B t | Hy t
B t | my
d | 10ph
t | Bd t
Oph | ect
my | U l t
O ph | t
ry | d | D d f
m | D d f
m | Rec
rr | Al
w th | Recu | D d t
rr | t | Al
dw ll—
5 y | Al
dw ll—
3 y | Al
dw ll—
6 m th t 3 y | Lo t | C
w th
in
m p l
f
gr w th |
|----------------------------------|----|----|-------------------------|-------------|---------|-----------|-------------|-----------|---------------|---------|---|------------|------------|-----------|------------|------|-------------|----|---------------------|---------------------|------------------------------|------|--|
| Papillary tubo ovarian cysts | 4 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Papillary fibro adenoma | 0 | 4 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 3 | 0 | 0 |
| Papillary cystadenoma | 21 | 14 | 0 | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 2 | 8 | 2 | 3 | 3 |
| Pap cystadenoma—unreviewed cases | 11 | 8 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 2 | 2 | 2 | 2 |
| Total papillary cystad | 45 | 29 | 0 | 16 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 4 | 17 | 7 | 5 | 5 |
| Carcinoma Grade I | 6 | 13 | 2 | 5 | 0 | 3 | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 | 4 | 7 | 7 |
| Carcinoma Grade II | 30 | 13 | 4 | 5 | 8 | 4 | 17 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 19 | 19 |
| Carcinoma Grade III | 16 | 10 | 0 | 0 | 6 | 1 | 7 | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 9 | 9 |
| Carcinoma miscellaneous | 14 | 7 | 1 | 3 | 3 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 6 | 6 |
| Carcinoma—unreviewed cases | 4 | 3 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 |
| Total carcinoma | 90 | 46 | 7 | 13 | 24 | 10 | 40 | 11 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 11 | 42 | 42 |
| Sarcoma | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Sarcoma—unreviewed cases | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| Total sarcoma | 4 | 3 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 3 |
| Final total | 39 | 78 | 7 | 30 | 24 | 12 | 42 | 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 16 | 7 | 29 | 19 | 50 | 50 |

END RESULTS OF TREATMENT

Primary mortality In the entire series of 139 cases there was a primary operative mortality of 8.6 per cent which can be divided into a rate of 2 per cent for the relatively benign tumors (fibro adenoma and papillary cystadenoma) and 11.8 per cent for the definitely malignant cases. The latter figure is not high considering the desperate character of many of the operations. Other writers have published their primary mortality statistics as follows: Mayfield (39) 5 per cent; Norris and Vogt (5) 5.2 per cent; Stuebler and Brandess (75) 11.4 per cent; Schaefer (67) 17.1 per cent; Byron and Berkoff (9) 20.3 per cent. These figures are of course closely related to the surgeon's conception of his duty toward the almost hopeless case in which the advisability of attempting an extensive operation is debatable.

Late results The pathologically reviewed group in this series of malignant and semi-malignant tumors (the latter exclusive of papil-

lary fibro adenomata and cysts of possibly tubal origin) comprises 109 cases of which 62 are known to be dead from the operation or the disease or to have had a recurrence; one has died from an intercurrent infection; 11 are lost; 10 have lived over 5 years (9 per cent); 5 more over 3 years (4.6 per cent); and 20 (18.3 per cent) are alive and well from 6 months to 3 years. Thus in all 32 per cent may be included in the group with a fair prognosis. Of the cases of true carcinoma (including 10 cases possibly secondary) there were 86 cases of which 59 are dead or have had a recurrence of the cancer; one has died from intercurrent infection; 9 are lost; 2 cases have remained well 5 years; 3 for 3 years; and 12 for a shorter period. Thus of the malignant group 5.8 per cent have passed 3 years and 13.9 per cent more are free from recurrence at least 6 months after operation, so that in all 19.7 per cent have a fair prognosis although only 2 out of 86 have actually passed the 5 year mark.

Stated in different terms—of the 11 cases of papillary cystadenoma and carcinoma operated upon over 3 years ago 15 are living 9 lost and 4 dead (absolute percentage of 3 year cures 11 per cent percentage of cures among traced cases 4 per cent) Of the 38 cases of true carcinoma treated at least 3 years ago 4 are dead 7 are lost and 5 are alive and well (absolute percentage of 3 year cures 85 per cent percentage of 3 year cures among traced cases 98 per cent)

A detailed summary of the results is given in Table I

The results are to be compared with those of the following

1. Noy and Vaght (52) of the University Hospital of Philadelphia report 1351 per cent alive in a series of 56 cases in which a complete cure is considered possible

2. Berman and Berkoff (3) of the Woman's Hospital New York reported 12 of 92 cases (14 per cent) living 6 months to 9 years which is quite comparable with the 10 per cent reported in the present series 6 months to 8 years

3. Mayfield (30) of the Mayo Clinic reported 17 series of 100 cases of papillary cystadenoma of which 30 per cent 123 lost and 38 living (4 possibly with cure) at an average of 3 years after the operation

4. Coleman (10) of Boston reported 15 cases of histologically malignant peritoneitis of ovarian origin in which the malignant cells were not observed and added more cases from a series of 41 patients operated upon at the Massachusetts General Hospital for carcinoma of the ovary with metastasis who had lived at least 4 years The exact pathology of these tumors is not definitely described and several tumors would in type might have been pseudomyoma

5. Liffert (156) of Kiel noted after 4 years a recurrence in 74 per cent of the cases (83 per cent for papillary carcinoma and 66 per cent for the non-papillary) but is able to report a rate of only 14.64 per cent 5 years

6. Gluckner (3) of Leipzig reported that 29 per cent of the cases which were observed 5 years were free of recurrence

Doedlin (1) of Munich found 10 of patients alive but only 6 living 15 years

8. Schriber (6) of University Clinic Berlin reported 14 per cent of 51 10-year cures among 100 cases of primary carcinoma in which operation was attempted but a total percentage of 13.1

9. Stuebler and Branl (75) of Tuebingen found 45 per cent of 11 cases alive and well over 3 years in their experience practically all recurrences took place within that time

Studies of any considerable number of cases treated with operation and radiation or radiation alone are infrequent but one or two reports indicate a definite improvement when the method are employed

10. Strassmann (74) of Berlin reported 132 cases of ovarian carcinoma treated by operation alone of which only 2 could be found alive after 1 year while of 10 cases receiving postoperative radiation 10 had passed 2 years and 2 were still over 6 years

11. Hysman (25) of Stockholm reported detailed results as follows on cases treated by radiation usually intra uterine or intravaginal radium and external X-ray Of 13 inoperable cases 2 were alive 1 year of 14 recurrent cases 2 were alive 2 years of 15 cases completely operated upon 2 years previously 40 per cent were alive and of 7 similar cases 42.9 per cent were still alive after 5 years finally following complete operation 66.7 per cent were alive 2 years and of 5 cases treated 5 years before 4 were still alive Heyman as well as Strassmann emphasizes the removal of as much of the tumor as possible before radiation

It will be seen that the percentage of definite cures varies from close to zero to about 40 per cent a variation which it seems must be due in part at least to the exact pathological types admitted by the pathologist to the category of malignancy It should be noted that in the Poosvelt series only 39 per cent of the definite carcinomata were limited even to the ovaries tube and uterus and as this represents practically the entire group from which surgical cure may be hoped for it seems probable that the reports of over 30 per cent must be based on a slightly different classification The histological borderline between some papillary cystadenomata and the early carcinomata is very vague and since these are the cases from which recoveries are likely to occur the hitting of a few cases one way or the other according to the personal attitude of the pathologist may greatly weight the end results for better or for worse

PROGNOSIS

The problem of prognosis may be approached from several angles

1. *Histology* This study indicates the following points

1. The simplest types of epithelial new growths fibro adenoma and the less active type of papillary cystadenoma never show

metastasis or implantations and are always benign although a similar growth may later develop in the opposite ovary. Furthermore it seems probable that if not removed the papillary cystadenoma may at times go through a series of changes in form until they develop malignant qualities.

2 There is a hyperplastic type of papillary cystadenoma easily confused with carcinoma that occasionally causes multiple implantations on the peritoneum which however the pathologist can assert will probably regress after bilateral oophorectomy. In this type the histology is the essential point in prognosis.

3 Once the diagnosis of carcinoma has been established beyond a doubt the ultimate fate of the patient depends little upon his biological degrees of malignancy for as soon as the growth has extended beyond the pelvic organs uniformly bad results are obtained surgically in all varieties. In two points however the histology conforms with the clinical measures of malignancy. In the first place the duration of life appeared to be somewhat influenced by histological structure the average time from operation to death being for Grade I 21 months for Grade II 5 $\frac{1}{2}$ months and for Grade III 13 months. Second the histological degree of malignancy was somewhat proportional to the stage of gross extension of the disease as indicated by the following table which shows the percentage of cases in each grade in which the tumor process had extended beyond the ovary.

| | P | T |
|-------------------------|----|---|
| Papillary cystadenomata | 13 | |
| Grade I carcinoma | 54 | |
| Grade II carcinoma | 83 | |
| Grade III carcinoma | 64 | |
| Miscellaneous carcinoma | 81 | |
| Total for all carcinoma | 73 | |

It should be noted that here as elsewhere Grade III (completely undifferentiated functionally) shows slightly less malignancy than Grade II with its greater nuclear irregularities.

II *Gross distribution in relation to prognosis in the malignant cases (exclusive of papillary cystadenoma)* The gross extension of the disease may be considered in four stages the prognosis for each stage being roughly indicated by the following results.

TABLE II—RELATION OF AGE TO DEGREE OF MALIGNANCY

| | All t m | | | p p l y t m | | |
|---------------|------------------------|-------------|----------|------------------------|-------------|----------|
| | E h ty
g g p
p t | | | E h ty
g g p
p t | | |
| | P b ty
t 38 | 38 t
m p | M p
d | P b ty
t 38 | 38 t
m p | M p
d |
| P l l y t d m | 44 | 33 | | 44 | 33 | |
| P l l y t d m | 3 | 43 | 6 | 38 | 43 | 9 |
| C m—G d I | | | 58 | 44 | | 44 |
| C m—G d II | 8 | 8 | 54 | | 3 | 7 |
| C m—G d III | | | 6 | 8 | 8 | 64 |

1 *Disease limited to one ovary* of 19 cases 6 patients are alive at least 6 months and 3 of them are alive over 3 years.

2 *Disease limited to both ovaries* of 5 cases 3 are alive at least 1 year and 1 3 years.

3 *Disease beyond ovaries but limited to uterus and tubes* of 10 cases 6 are alive at least 6 months but none has yet reached 3 years.

4 *Disease beyond female pelvic organs* of 64 cases only 1 is alive this case being in good health 4 years after an operation requiring partial removal of the omentum.

From the statistics it may be said that of the cases apparently limited to the removable pelvic organs nearly half (44 per cent) have at least a fair prognosis while cases in which the disease has progressed further are almost hopeless.

The bad prognosis of bilateral as compared to unilateral carcinoma has always been emphasized. Thus for example Schaefer (67) found recurrence in 97.8 per cent and Glocker (17) in 100 per cent of bilateral cases. Yet it seems probable that these very bad figures for bilateral tumors must be partly attributed to the fact that this group contains most of the cases with the generalized peritoneal carcinomatosis and the prognosis for simple bilateral tumors does not appear quite so unfavorable when the cases with metastasis are separated from them.

Ascites in itself seems from these studies to have rather little direct bearing on the prognosis since 2 of the 5 3 year cures each showed several quarts of peritoneal fluid, this being

sanguineous in one instance. Ascites is of course more frequent in the advanced cases.

III *Age* There was some distinct evidence that the younger patients had a slightly better prognosis. In the first place the degree of malignancy appeared to be proportional to the diminution of the ovarian function. In order to show the age relationship the cases have been divided into three groups depending upon the theoretical state of the ovarian function. The first group includes all those cases from puberty up to 38 years of age during which time the ovarian function must be said to be relatively high; the second group between the years from 38 to the menopause during which time the ovarian function is on the wane; and the third group all those which have passed the menopause at which time the ovarian function becomes markedly deficient. This classification based on physiological age even though it only approximates the true condition seems to be far more logical particularly in the study of gynecological conditions than the customary arbitrary division of cases into decades.

Table II shows the relative frequency of carcinoma Grade I and papillary cystadenoma among young women and the similarly high proportion of carcinomata of the second and third degree among women who have passed the menopause. This relation of increasing age to degree of malignancy was more apparent in the typical papillary serous cystadenomata and carcinomata than in the mucous and glandular tumors a fact which may be of significance.

It has appeared to us also that to a small extent the younger women had a slightly better prognosis aside from the difference in the degree of malignancy to which they are disposed. In the first place of the 4 patients with papillary cystadenomata with ascites or implants who recovered all were under the menopause and 3 under 38. Of the 5 patients with true carcinoma who have lived over 3 years are under 38 (a third under 38 died of pneumonia at 4 years); 1 other case 1 under the menopause and only 1 have passed it.

IV *The form of operation in relation to prognosis* The relation of the type of operation to the result is not amenable to statistical

analysis in this series because in almost every instance in the treatment of the malignant cases partial operation was resorted to only when the technical difficulties offered by an extensive growth prohibited the radical procedure. In only 1 case has a recurrence followed an incomplete operation which might have been avoided by a more extensive one. This was in a case of sarcomatous cyst which was removed without the recognition of its true nature. One year later there was a similar cyst on the opposite side as the result of the removal of which the patient died. On the other hand in 3 of the cases in the series previous operations had been done in some other institutions at a time sufficiently near to the occasion of the development of the present condition to make it appear probable that it was a recurrence of a tumor in the ovary that had not been removed at the previous operation. It may be said then that a complete operation favored somewhat the chances of a perfect recovery.

V *Postoperative radiation* The cases in our series that have received radiation 10 in number are too few for comparison with those that have not received it but there is definite evidence from an examination of these cases to indicate that the duration of life following radiation is definitely increased although we can report no cures that can be ascribed to the use of radium or X Ray. Heymans and Strassmann's detailed results on radiated cases are referred to elsewhere in this article.

PATHOLOGY OF PELVIC ORGANS CONCIDENT WITH OVARIAN NEOPLASMS

The pathology of the other organs of the reproductive tract was studied in the hope that this might give some insight into the general state of the genital apparatus at the time of the development of the ovarian neoplasm.

1 *The opposite ovary* The reports on the pathological condition of the second ovary were studied in 9 cases of definitely primary ovarian growth in which full detail were available for classifying the condition. The cases with such massive peritoneal involvement as to make doubtful the exact relations in the pelvis and cases in which both ovaries had been previously removed were excluded.

TABLE III—CONDITION OF THE SECOND OVARY IN ASSOCIATION WITH NEOPLASMS OF FIRST OVARY

| | T t l | | | B i l | | | P m p p o s i t | | | N m l | | | S i t | | | C y t | | |
|--|-------|----|------|-------|------|----|-----------------|------|------|-------|------|------|-------|---|----|-------|---|----|
| | N | N | cr | N | N | cr | N | N | cr | N | N | cr | N | N | cr | N | N | cr |
| Papillary fibro adenoma | 9 | 2 | 22 2 | 0 | 0 | 0 | 4 | 44 4 | 0 | 0 | 3 | 33 3 | | | | | | |
| Papillary serous cystadenoma | 15 | 5 | 33 3 | 2 | 13 3 | 2 | 13 3 | 1 | 6 6 | 5 | 33 3 | | | | | | | |
| Papillary serous carcinoma | 34 | 4 | 70 6 | 4 | 11 8 | 1 | 2 0 | 3 | 8 7 | 2 | 5 8 | | | | | | | |
| Total serous tumors | 58 | 31 | 55 2 | 6 | 10 3 | 7 | 12 1 | 4 | 6 8 | 10 | 17 3 | | | | | | | |
| Papillary mucous cystadenoma | 5 | 0 | 0 | 0 | 0 | 0 | 4 | 80 0 | 0 | 0 | 1 | 20 0 | | | | | | |
| Papillary mucous carcinoma | 10 | 1 | 10 0 | 1 | 10 0 | 2 | 0 0 | 1 | 10 0 | 5 | 50 0 | | | | | | | |
| Colloid carcinoma | 2 | 1 | 50 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 60 0 | | | | | | | |
| Total mucous tumors | 17 | 2 | 11 8 | 1 | 5 9 | 6 | 35 3 | 1 | 5 9 | 7 | 41 3 | | | | | | | |
| Glandular carcinoma (including perhaps a few metastases) | 12 | 5 | 41 6 | 1 | 8 4 | 2 | 16 8 | 1 | 8 4 | 3 | 25 2 | | | | | | | |
| Solid carcinoma (teratoma?) | 3 | 0 | 0 | 0 | 0 | 0 | 66 6 | 0 | 0 | 1 | 33 3 | | | | | | | |

The Table III shows the far greater tendency of the serous papillary cystadenomata and cystadenocarcinomata to be bilateral as compared with any other variety and the much greater frequency of normal ovaries in association with the pseudomucinous and solid tumors. It should be noted that of the 15 normal ovaries only 3 were examined pathologically the others being noted as normal by the operator.

This occurrence of bilateral development in these different types is quite in accord with most other published statistics. Thus Pfannenstiel (56) reports pseudomucinous cysts as being bilateral in 17.1 per cent the papillary serous cysts in 60 per cent papillary adenocarcinoma in two thirds but solid carcinoma in only two fifths of the cases.

II *The fallopian tubes* In the 70 cases associated with true malignancy of the ovary in which definite mention is made of the condition of the tubes 35 showed cancerous involvement, 20 were normal and 15 showed some signs of a chronic salpingitis usually in the form of dense adhesions. The latter finding should almost certainly not be interpreted as in any sense a causative factor but rather as an inflammation incidental to the malignant growth.

III *The myometrium* Fibromyomata were of rather extraordinary frequency oc-

curring in 3 of 83 (3.8 per cent) of the definitely primary tumors in which the details of the history were complete and the operation such that the uterus could be satisfactorily examined. The more detailed analysis of the types of ovarian tumor associated with fibromyomata revealed the following facts:

1 Pseudomucinous tumors were accompanied by fibroids as often as the serous tumors (35 per cent and 39 per cent).

2 The more benign types of both groups were more often found to show coincident fibroids than the more malignant varieties.

3 The incidence of fibromyomata was greater in the higher age groups the cases below 38 showing 12 per cent fibroids, the cases from 38 to the menopause 53.5 per cent those above the menopause 45 per cent.

IV *The endometrium* This is a feature that deserves a careful study in connection with ovarian disease but which cannot be done in the present series on account of the deficiency of the uterine slides. Of 3 cases in which slides were available 3 showed a definite hyperplasia 5 a suggestion of hyperplasia and 15 were within normal limits. No conclusions could be drawn as to the type liable to hyperplasia. To these groups should possibly be added 5 cases of carcinoma of the endometrium associated with carcinoma of the ovary.

TABLE IV - ASSOCIATION OF FIBROMYOMATA UTERI WITH OVARIAN NEOPLASMS

| | All | | | | Fertility | | | | Sterility | | | | Miscellaneous | | | |
|---|-----|---|-----|---|-----------|---|---|---|-----------|----|----|---|---------------|----|-----|---|
| | T | F | L | C | T | F | L | C | T | F | L | C | T | F | L | C |
| Fibroid | 9 | 5 | 55 | | 4 | | 5 | | 3 | 3 | 00 | | | 0 | 0 | |
| Fibroid + leiomyoma | 5 | 8 | 53 | 1 | 6 | | 6 | | | 5 | | | 2 | 2 | 100 | |
| Fibroid + myoma | | 7 | 60 | 0 | 0 | 0 | 0 | | | 3 | 43 | | 14 | 4 | 24 | |
| Fibroid + myoma + leiomyoma | 5 | | 13 | | 3 | 0 | 7 | 1 | | 64 | | | 18 | 6 | 33 | |
| Fibroid + leiomyoma | 6 | 3 | 50 | | 1 | | | | 3 | | 33 | | | 2 | 00 | |
| Fibroid + myoma + leiomyoma + leiomyoma | 8 | 2 | 5 | 2 | | 0 | | | | 0 | | | 4 | | 5 | |
| Fibroid + myoma | 1 | 1 | 33 | | 0 | | | | 1 | 50 | | | | | | |
| Fibroid + myoma | 7 | 6 | 35 | 4 | | | | | 2 | 4 | | | 6 | 4 | 66 | |
| Fibroid + leiomyoma + leiomyoma | | 4 | 36 | 3 | 0 | | | | 3 | 2 | 66 | | 5 | 2 | 4 | |
| Fibroid + myoma + leiomyoma + leiomyoma | 4 | | 50 | | 0 | | | | 0 | 0 | | | | 2 | 00 | |
| Total | 91 | 3 | 393 | 4 | 3 | 5 | 9 | 5 | 5 | 53 | 5 | 3 | 4 | 45 | 1 | |

ETIOLOGY

In a somewhat philosophical article in 1911 (16) (17) emphasized a point too often lost sight of that whatever other factors there might be in the cause of cancer senility was certainly an important one. He pointed out furthermore that particular parts of the body aged earlier than others the female genitalia being example of organs having an early age atrophy and that possibly for this reason carcinoma of the female reproductive tract occurred rather earlier than in other organs.

The rather high incidence of ovarian carcinoma just before or after the menopause may be perhaps partially explained on the basis of the factor of local senility and lowered function and there are some suggestion in the literature to indicate that ovarian carcinoma in a young person has a relatively high incidence among women with hypoplastic genitalia. For example Meyer (46) among other has described a more or less peculiar pleurocarcinoma occurring in hermaphrodite pseudohermaphrodite and occasionally in certain other individual. Hick (35) has noted a peculiar tubular adenoma in similar cases.

Lippincott (47) in a recent article on embryonal carcinoma gave histories of 6 cases 4 of which showed marked abnormality of the ovarian function. A possible morpho-

logical explanation for the occurrence of tumors in underdeveloped ovaries is found in part of Goodall's (20) embryological studies in which it is demonstrated that interference in the vascular supply during fetal life of all or part of the ovary results in the failure of the normal atrophy of certain fetal structures and the persistence of numerous embryonal remains as fertile soil for the development of neoplasms.

Were it true that the incidence of malignant and semi malignant conditions in older women was dependent to some extent on the physiologically lowered function of the menopause and the incidence in younger women on a congenital or early acquired hypoplasia then there should be differences between the degree of fertility and the characteristic menstrual cycles of the women who develop these tumors at different epochs. For the purpose of searching for some such possible relationship the cases were again divided into three physiological age group of full ovarian function up to 35 year of diminishing function from 35 year to the menopause and of deficient function above that stage. The results obtained follow.

1. Fertility. Of the married women who developed papillary cysts or carcinoma the following percentage at different ages have had at least one child.

TABLE V—RELATION OF FERTILITY IN MARRIED WOMEN TO OVARIAN NEOPLASMS

| | All g | | | P b ty t 38 | | | 38 t m p | | | M p | | | J ld |
|------------------------------|-------|-----------------|------------|-------------|----------------|----------|----------|----------------|----------|-------|----------------|----------|------|
| | T t l | N mb w th Ch ld | er f t l e | T t l | N mb w th h ld | er f t l | T t l | N mb w th h ld | er f t l | T t l | N mb w th h ld | er f t l | |
| Papillary fibro adenoma | 7 | 3 | 43 | 2 | 0 | 0 | 3 | 1 | 33 | | 2 | 100 | |
| Papillary serous cystadenoma | 11 | 7 | 64 | 3 | 2 | 66 | 4 | 4 | 100 | 4 | 1 | 5 | |
| Papillary serous carcinoma | 29 | 11 | 38 | 6 | 1 | 17 | 7 | 3 | 43 | 16 | 7 | 44 | |
| Total serous | 47 | 21 | 45 | 11 | 3 | 27 | 14 | 8 | 56 | 2 | 10 | 45 | |
| Papillary mucous cystadenoma | 4 | | 50 | 1 | 0 | 0 | 1 | 1 | 100 | | 1 | 50 | |
| Papillary mucous carcinoma | 5 | 4 | 80 | 2 | 1 | 50 | 1 | 1 | 100 | 2 | 2 | 100 | |
| Colloid carcinoma | 1 | 0 | 0 | 1 | 0 | 0 | | | | | | | |
| Total mucous | 10 | 6 | 60 | 4 | 1 | 25 | 2 | 2 | 100 | 4 | 3 | 75 | |
| Glandular carcinoma | 8 | 3 | 37 | 3 | 0 | 0 | 2 | 1 | 50 | 3 | 2 | 66 | |
| Solid carcinoma | 3 | 2 | 66 | | | | 1 | 0 | 0 | 2 | 2 | 100 | |
| Miscellaneous carcinoma | 11 | 6 | 55 | 2 | 1 | 50 | 1 | 0 | 0 | 8 | 5 | 62 | |
| Total all forms | 79 | 38 | 48 t | 20 | 5 | 25 | 20 | 11 | 55 | 39 | 22 | 56 4 | |

Under 38 (5 cases in 0) P e t
 From 38 years to menopause (11 cases in 0) 5
 Over menopause (22 cases in 39) 56

The point in question is of course not the relation of ovarian tumors to the absence of pregnancy but to the physiological inability to become pregnant and it is quite possible that some of these early cases might have later produced children had the tumor and the operation not intervened. Yet the average time married in this early group was 6 years and in all only 1 children had been produced (6 by one case). To balance the possible increase in percentage of fertile women in the earlier groups had they been married for a longer period is the conceivable increase in the percentage of the theoretical fertility of the older group had some of them married at an earlier age. Definite conclusions can of course not be drawn from these figures on account of lack of statistics on the normal fertility ratios of women at these different ages but there is certainly some indication that the women who developed tumors late in life had originally a more nearly normal reproductive apparatus than those who developed it in the earlier years. The detailed study of the fertility of the individual varieties of ovarian tumor revealed that in this series no particular

type could be definitely said to be prone to occur in sterile women but other statistics have revealed a decided difference. Thus Stuebler and Brandess report sterility as follows

| | P e t |
|------------------------|-------|
| Secondary tumors | 3 03 |
| Pseudomucinous cysts | 6 3 |
| Dermoids | 4 |
| Papillary carcinoma | 0 4 |
| Papillary serous cysts | 5 |

The relation of the tumors in the present series to fertility follows

2 *Menstruation* For the purpose of comparing the menstrual peculiarities those cases were considered more or less arbitrarily as atypical in which the characteristic (ie original) cycle showed periods coming more often than every 26 days or less often than every 30 days and those in which the duration was less than 3 or more than 5 days. On this basis the following percentages of cases with atypical menstrual cycles were found at the ages indicated

| | P e t |
|---------------------------------|-------|
| Under 38 (1 of 26 cases) | 46 1 |
| 30 to menopause (13 of 9 cases) | 44 8 |
| Above menopause (9 of 30 cases) | 30 3 |

Taking however those cases in which there was only an abnormally long interval or short duration the following results were obtained

TABLE 53—MENSTRUAL CHANGES
AS ASSOCIATED WITH OVARIAN NEOPLASMS

| | | T 1 P | |
|---------|------|-------|----|
| Liberty | 38-6 | sec | |
| Dec | f | n | rd |
| F | 1 | 1 | 1 |
| Age | 38 | m | 1 |
| ase | f | 1 | rd |
| Dec | f | 1 | rd |
| T | 1 | 1 | 1 |
| O | m | 1 | 1 |
| R | m | 1 | 1 |
| Dec | f | 1 | 1 |
| T | 1 | 1 | 1 |
| Incl | J | 1 | 1 |
| | | P | |
| U | d | 38 | 8 |
| ase | f | 1 | 1 |
| Dec | f | 1 | 1 |

Here again the statistics and especially the inability of the older women to remember the minor irregularities of years before may lead to an error but there is once more a suggestion that the young women who develop ovarian neoplastic disease have a definitely lower inherent ovarian functional capacity as indicated by menstrual irregularity than those which developed the disease after the physiological decline in activity. Studies of the separate varieties of tumors in relation to menstrual irregularities gave no additional information although a larger series might yield significant figures.

Some change in the form of menstruation appearing shortly before the entry of the patient into the hospital is also very common. This manifests itself sometimes in an increase sometimes in a decrease in the duration and frequency. It usually has its onset near enough to the time of the operation to indicate that it is possibly a result of the tumor and not associated with the cause of it although sometimes it may antedate the development or at least the actual discovery of the tumor by several years as in the case of a girl who had had an amenorrhoea for years before the operation. The change in type occurring shortly before the operation must be strongly differentiated from the abnormality of the individual characteristic menstruation as discussed above. That these new abnormalities are not all due to the ovarian growth is obvious when the high percentage of fibroid in

the group is considered and when it is also remembered that in the middle group in particular the effect of the menopause is being felt. Furthermore it should be explained that the standard history form used on the Koo's Gynecological Service requires searching inquiry into menstrual change, small variations being often thus noted which would not otherwise appear among the presenting symptoms. The statistics in the accompanying table include such minor variations and yet it must be concluded that the majority of patients on entering the hospital are suffering from some disturbance of the ovarian function whether pathological or physiological.

The evidence in favor of the existence of a strong constitutional factor in the origin of ovarian neoplasms is therefore based on the following points:

1 The frequent occurrence of ovarian neoplasms especially of the more malignant varieties at or near the menopause.

2 The relatively high percentage of sterility and menstrual disorders in the women who develop a new growth before the time of the normal decline in ovarian activity.

3 The constant increase in the average degree of histological malignancy with increase in age and the diminution of physiological capacity.

4 The frequency of multicentric origin of ovarian tumors in the sense of bilateral papillary cysts and of multiple papillomata in the various chambers of a multilocular cyst and possibly also in that of coincident uterine carcinoma.

5 The common association of ovarian growths with cystic ovaries and with fibromyomata uteri both of which conditions are probably indicative in themselves of slight sexual deficiency.

Most of these facts are outlined pertain especially to the serous group of tumors which is especially interesting when it is considered that carcinoma of the uterine fundus an histologically related type has many comparable features in its etiology. Thus in a report of 186 cases of fundus carcinoma Mahle (31) gave the following figures: average age of incidence 55.1 per cent sterility among married 33.3

per cent coincident fibromyomata 55.4 per cent. These similarities in etiology are of particular note in view of the current theory of origin of some ovarian cancers from heterotopic endometrial tissues.

TREATMENT

Early diagnosis is almost impossible in most cases on account of the long symptomless period of the disease and the considerable extent to which the process has already attained when the patient first becomes aware of any thing being wrong. Periodic gynecological examination offers probably the only hope of detecting any considerable number of early cases.

Ovarian cysts even when believed to be benign must be tentatively regarded as precancerous and removed as soon as possible for in all cases a papillary process may be present within the cyst or may be on the point of developing. Ovarian cysts in older women should cause particular suspicion of malignancy.

In the probably malignant cases with ascites exploratory operation is still indicated for some of these patients are without peritoneal metastasis and may recover especially in the earlier age group.

In the still more advanced cases no matter what the size of the cyst and even when peritoneal implants are thought to be present before the operation exploration should still be made in the hope that the neoplasm will be localized or that it will be of a histological type that will regress after hysterectomy and also for the reason that radiation therapy may be more satisfactory after at least a part of the tumor mass has been removed.

The contra indications to operation are the following:

1. Marked cachexia which renders the mortality from operation inordinately high.

2. Fixity of the pelvic structure indicating the probability of the existence of an almost insuperable technical obstacle to hysterectomy.

3. Large masses in the upper abdomen which may indicate that the ovarian growth is secondary to a gastric tumor or that a primary growth is relatively far advanced. In this series the tumors with relatively benign histology formed only tiny implants (the con-

ventional term in the reports of similar cases being a peppering of the peritoneum) while the larger solid masses were invariably formed by a highly malignant growth rendering the condition in consequence quite hopeless.

4. The presence of gastro intestinal symptoms which with roentgenological examination indicate the probability of a primary tumor being present somewhere in the alimentary tract.

The type of the operation depends on the nature of the tumor and the age of the patient.

1. In the malignant papillary carcinoma the procedure is invariably hysterectomy and the removal of both tubes and ovaries even though only one side is visibly diseased.

In sarcoma and teratoma occurring in very young women the strong tendency of these tumors to remain for some time unilateral may be considered a sufficient justification to limit the operation to a unilateral salpingo oophorectomy if the disease is still strictly localized.

3. In the case of a unilateral serous cyst of the benign type with only a relatively small number of warty papillae in the cyst the opposite ovary after careful examination may be left in a woman under 35 years but if it is at all cystic the strong tendency of the disease to develop bilaterally must be remembered and all factors weighed before one ovary is allowed to remain.

4. In the cases of pseudomucinous cyst on the other hand since these tumors also tend to remain unilateral if the opposite ovary is grossly normal and the papillae of the cyst are relatively small or limited to a few loculi and there are no hard nodules in the cyst wall the opposite ovary and the uterus may be preserved.

The question of complete or supravaginal hysterectomy is a debatable one though it appears from our observation that there are few cases in which the course of the disease can be greatly affected by the larger operation. It should however be performed when it does not add greatly to the difficulties of the procedure.

Omental nodules discovered after laparotomy if not numerous may be removed if the condition of the patient permits but the

resection of organs secondarily involved such as bladder colon or sigmoid appear from our statistics to be a dangerous and futile procedure

To operative radiation should never be omitted in any malignant case. The cases so treated in this series have been too few to permit conclusion to be drawn but some clinics report definite improvement in their results by using postoperative deep X ray therapy and it will be used routinely on the Roosevelt service in the future

Treatment by external X ray with intra vaginal or intrauterine radium should also be tried in the moderately advanced inoperable cases in the hope that the growth may prove radiosensitive. Occasionally inoperable cases are rendered operable and even isolated cures have been reported by this method. Furthermore it seems probable that unless the patient's general condition is already so poor as to render the radiation immediately dangerous a definite prolongation in the duration of life can be obtained in most cases.

CENTRAL SUMMARY AND CONCLUSIONS

1 This study is based upon a clinical and histological review of 139 cases of tumors diagnosed as papillary cystadenoma primary carcinoma and sarcoma of the ovary.

The present view of the origin of primary epithelial tumors of the ovary indicates that a certain mixed group is of teratomatous origin and that this group possibly include the pseudomucinous tumor while the common mucinous cyst and its hyperplastic and malignant varieties arise from the germinal epithelium or abnormally placed endometrial tissue.

2 A study of the types of ovarian tumor in their various stages of hyperplasia and malignancy is given with a description of the histology and the end results in each group.

3 As regard the histological criteria of malignancy it is found in ovarian tumors that loss of differentiation does not carry with it so severe a prognosis as the presence of marked nuclear irregularity even though the latter occur in tumors the structure of which shows moderate functional differentiation. For this reason Group III of completely undifferentiated cell showed slightly better results than

Group II partially differentiated but with marked nuclear irregularity.

4 The operative mortality depends chiefly on the election of the case. In this series the mortality was 11.5 per cent for the true carcinoma and 1 per cent for the semimalignant papillary tumors.

5 The percentage of late cures reported depends partly upon the pathological conception of where to draw the line of malignancy. Of the positively malignant cases that have passed 3 years the absolute percentage of cures in this series is 18.5 per cent while if the actively growing papillary cystadenomata are included the result becomes 31 per cent in each figure the untraced cases being counted as dead.

6 Prognosis is vitally dependent upon histology only in the unusual type that may cause peritoneal implantation and recur after complete hysterectomy. This variety may be in the nature of a hyperplasia of a peritoneal endometrium.

7 Prognosis is however dependent almost directly upon the degree of the extension of the growth for when there is a cancer beyond the ovaries uterus or tubes the results are usually bad with the exception of a rare cure with the aid of X ray.

8 The younger the patient the more benign the histology is liable to be.

9 The pathology of the generative organ associated with the ovarian tumors include a high percentage of fibromyomata frequent cystic degeneration of the uninvolved ovary when the disease is unilateral and at times possibly a hyperplasia of the endometrium.

10 As possible etiological factors in the development of ovarian carcinoma are the physiological diminished function of the menopause and a congenital underdevelopment in women who developed the disease early. In substantiation of this theory are given showing the lower fertility and the scantier menstruation in younger women with ovarian tumors.

11 The treatment if possible should be complete hysterectomy with removal of both ovaries (except in rare instances) and postoperative radiation should invariably be given in the malignant cases.

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CRANIAL CHANGES ASSOCIATED WITH MENINGIOMA
"DURAL ENDOTHELIOMA" 1ANATOLE KOLODNY, M.D., Ph.D., F.A.C.S., IOWA CITY, IOWA
Internist, St. Joseph's Hospital, Iowa City, Iowa

WHILE the frequent presence of changes in the skull overlying a meningioma is well known the nature of these changes is still under discussion. The view that the localized thickening of the skull is the primary tumor with the meningioma proper as a secondary intracranial extension is at present entirely abandoned. Notwithstanding the fact that in 1906 Barling and Leith (1) showed the presence of tumor cells of the meningioma type throughout the bony thickening the latter was looked upon as a simple cranial hyperostosis which resulted from an irritation by the underlying dural growth. Only since Cushing's contribution of 1922 (2) has the fact generally been appreciated that the thickening of the skull overlying a meningioma is infiltrated by tumor.

Cushing's report was soon followed by other studies the foremost of which were those of Phemister and of Penfield. In a discussion of the nature of the cranial changes various investigators departed from an *a priori* accepted view which has never been definitely proved. They believed that bone proliferation follows upon and is a direct result of the infiltration of the skull by tumor cells. As Cushing expresses it "under the influence of intracranial tension the tumor cells in the process of their multiplication become crowded into and through the vascular dural spaces and finally into the canaliculi of the bone." In consequence of this the bone becomes irritated with subsequent osteoblastic proliferation which provokes the hyperostosis (p. 148). The conclusions reached have been influenced by this view. That the knowledge of the character of these osseous changes and of their mechanism of production is nebulous and confusing one may judge from a study of the contributions to this subject. Thus Penfield (4) referring to the intracranial and cranial portions of the neoplasm says: "It seems most unusual that in one part of a neoplasm osteogenesis should occur while in the other

part there is none." Phemister (5) states on page 566: "It (the new bone) grows out of the old bone." In the summary on page 57 he concludes: "The new bone is not tumorous in nature and is usually ossified stroma of the invading endothelioma." It is evident that the last two statements contradict each other since if the new bone grows out of the old bone it cannot represent ossified stroma of the invading endothelioma. Then again if one admits that the stroma of the cranial portion of the tumor does ossify, how is it that the intracranial portion and for that matter also the extracranial portion of the tumor after the latter perforated the skull does not ossify to any appreciable extent?

The accepted opinion that the proliferation of bone is a result of its stimulation by the infiltrating tumor cells has influenced the studies of this subject in yet another way. One usually hears of proliferative processes in the overlying skull but the fact that destruction of bone accompanies the proliferation in most cases has received little appreciation as one can see from the titles of the studies in which the authors refer to cranial hyperostosis or osteoma.

A study of the bone flaps and the tumors removed from ten patients with meningioma at the National Hospital, Queen Square, London leads me to believe that the assumption that the thickening of the bone is a result of irritation of the latter by infiltrating tumor cells is erroneous. The bone proliferation precedes the actual infiltration of the bone by the tumor cells and probably is a result of an early, especially slowly progressing dilatation of the blood vessels in the portion of the cranium overlying the meningioma while the subsequent infiltration of the bone by tumor leads to bone destruction.

The fact that *local* changes in the skull overlying an intracranial tumor are observed almost exclusively in meningioma and are not seen in cerebral gliomata suggests a leading

question How does a meningioma differ from other brain tumors in its relation to the overlying skull? The fact alone that in meningioma the tumor is attached to the dura is insufficient for an explanation of the cranial changes since occasionally gliomata reaching the cortex adhere to the overlying skull. The foremost difference is the blood supply. While gliomata are supplied by cerebral blood vessels, meningiomata depend upon meningeal blood vessel for their supply. The wide communication of the meningeal veins with the diploic vein is the anatomical basis upon which rests the influence of a meningioma on the overlying skull. The meningeal veins which are easily collapsed under local pressure would be insufficient for the blood supply of the growing neoplasm if it were not for these communications. The latter lead to a marked enlargement in size and increase in number of the diploic veins in the cranium close to the tumor. Without appreciation of this radical difference of the blood supply of a meningioma from that of other cerebral tumors, Elsberg and Schwartz (3) arrived at the same conclusion from studies of radiograms of random case of intracranial tumors. To quote these authors: "We have therefore arrived at the conclusion that if the diagnosis of brain tumor has been made and unilateral enlarged diploic channel are found in the general area in which the tumor is suspected, there is considerable probability that the new growth is an endothelioma."

When the radiological evidence of dilated blood vessel is correlated with microscopical studies of sections passing through the entire affected area of the skull overlying a meningioma, one is impressed by the fact that these dilated blood channels are present mainly in the periphery of the affected portion of the bone (Fig 1). It is in the periphery that it is best to study the early change in the bone that follow such a dilatation of the blood channel. For nearer the center the changes are too far progressed to allow a reliable analysis. Approaching the periphery from areas of normal skull one may see in the bone the appearance and progress of two changes that go parallel: a dilatation of blood channel and an apposition of new bone on the internal and

external surface of the skull. This dilatation of blood vessel is not limited to the diploe but is outstanding in both plates of the bone. The proliferation of new bone is most striking on the internal and external surface of the skull where it is easily distinguishable as layers of new bone superimposed on one another. The increase of the degree of dilatation of the blood channels toward the central portion of the affected area of the skull parallels the increasing amount of new bone.

These findings are most convincing although it is difficult without speculation to explain the relationship between dilatation of blood channels and bone proliferation. Our present knowledge of osteogenesis is limited to hypothetical considerations many without actual facts to support them. It is evident that had this dilatation of blood channels progressed more rapidly it would have resulted in mere destruction of bone but the extremely slow dilatation of the channels, most likely a process stimulating proliferation of bone whether it be by keeping the periosteum under increased tension because of venous stasis in the bone or through other unknown factor.

Advancing in the microscopical study from the periphery to the center one can follow the varying extent of infiltration of the overlying skull by tumor cells. First they appear in the diploe. Because of less resistance the cell spread here farther than in the adjoining external or internal tables (Fig 2). Soon however tumor cells are noticed in the internal table and in the new bone about it. Finally in an area nearer the center the tumor cells are seen in the external table and in the adjoining new bone. After the tumor cell have made their way through the external table they spread through the soft coverings of the skull far more extensively than in the external table (Fig 3). The tumor cells show a tendency to spread along lines of lesser resistance thus aside from filling the enlarged Haversian canal and dilated blood space, they spread between the bony lamellae frequently emphasizing by this the separate layers of the newly formed bone. This passage of the tumor cells is also well seen in the infiltration of the soft tissues covering the skull after the tumor cell have perforated the bone they spread along

fascial planes and through areolar connective tissue space compressing rather than destroying the surrounding normal structures. In view of this passiveness of the tumor cells it is preferable in spreading of meningioma to use infiltrate rather than invade.

The passiveness of the tumor cells does not preclude their ability to destroy bone after they have spread throughout its canals and lacunae. Histological studies show various phases in this bone destruction which viewed largely does not differ from destruction of bone by any other mesoblastic tumor spreading in it. The tendency of the tumor cells to multiply though enclosed in bony chambers leads to gradual pressure absorption of the walls of these chambers. Occasionally one encounters an active bone destruction which is accomplished through the assistance of normal osteoclasts. This active destruction however is rare. The dense bone of the table proper is extremely resistant to destruction so that even in the advanced cases of cranial changes one may easily distinguish the outlines of both tables microscopically as well as in the radiogram of a slice of the removed bone flap (Fig 5). Destruction of the new formed bone on the intracranial side of the skull may lead to irregular jagged excrescences of bone surrounded by soft tumor (Fig 4).

The arrangement of the new formed bone is of some interest. The most frequent arrangement is in layers parallel to the surface of the skull. This arrangement of bone is readily understood if one considers the periosteum responsible for its production. The parallel striation of the new formed bone can be appreciated only in microscopical studies while in the radiogram they cannot be distinguished because they coalesce in the shadow. Occasionally the new bone is arranged in spicules perpendicular to the surfaces of the skull. On the cut section of the gross specimen one sees numerous dense glistening strie which are closely aggregated at their base on the bone surface and arranged perpendicularly to the external and internal table of the skull. Topographic microscopical studies show bands of connective tissue which divide the proliferated new bone into radiating columns by dipping into it at irregular intervals. Blood vessels fre-



Fig 1. Radiogram of a bone flap overlying a meningioma. Note the widely dilated diploic veins in the periphery.

quently accompany these bands and between them numerous dainty spicules of bone are seen running perpendicularly to the tables of the skull. It appears as though the course of the blood vessels and bands predetermines the course of the bony spicules. Phenister expressed an opinion that the new formed bone is always arranged to support the tumor. Histological evidence does not support this view. When present the perpendicular arrangement of the bony spicules is found also in the periphery where no infiltration of tumor cells is seen while in the central portion of the affected bone area where tumor is seen in abundance bony spicules are less abundant (Fig 5).

The degree of bone proliferation and the amount of new formed bone vary greatly with each case. Cushing pointed out the fact that the proliferation of new bone is greatest in the first variety of meningioma, the so called meningioma *en plaque*. Three cases of meningioma *en plaque* in the present series support this observation. The dilatation of vascular channels in these three cases extended over a much wider area than in the ordinary spherical meningioma. Microscopically the infiltration of bone by tumor cells was really negligent extending over a smaller area and permeating only the intracranial portion of the bone. This wider and more extensive dilatation of the blood channels of the overlying skull coupled

question How does a meningioma differ from other brain tumors in its relation to the overlying skull? The fact alone that in meningioma the tumor is attached to the dura is insufficient for an explanation of the cranial changes since occasionally gliomata reaching the cortex adhere to the overlying skull. The foremost difference is the blood supply. While gliomata are supplied by cerebral blood vessels meningiomata depend upon meningeal blood vessels for their supply. The wide communication of the meningeal veins with the diploic veins is the anatomical basis upon which rests the influence of a meningioma on the overlying skull. The meningeal veins which are easily collapsed under local pressure would be insufficient for the blood supply of the growing neoplasm if it were not for these communications. The latter lead to a marked enlargement in size and increase in number of the diploic veins in the cranium close to the tumor. Without appreciation of this radical difference of the blood supply of a meningioma from that of other cerebral tumors, Elsberg and Schwartz (5) arrived at the same conclusion from studies of radiograms of random cases of intracranial tumors. To quote these authors: "We have therefore arrived at the conclusion that if the diagnosis of brain tumor has been made and unilateral enlarged diploic channels are found in the general area in which the tumor is suspected there is considerable probability that the new growth is an endothelioma."

When the radiological evidence of dilated blood vessels is correlated with microscopical studies of sections passing through the entire affected area of the skull overlying a meningioma one is impressed by the fact that these dilated blood channels are present mainly in the periphery of the affected portion of the bone (Fig. 1). It is in the periphery that it is best to study the early change in the bone that follows such a dilatation of the blood channel. For nearer the center these changes are too far progressed to allow a reliable analysis. Approaching the periphery from areas of normal skull one may see in the bone the appearance and progress of two changes that go parallel: a dilatation of blood channel and an apposition of new bone on the internal and

external surface of the skull. This dilatation of blood vessels is not limited to the diploic but is outstanding in both plates of the bone. The proliferation of new bone is most striking on the internal and external surface of the skull where it is easily distinguishable as layers of new bone superimposed on one another. The increase of the degree of dilatation of the blood channels toward the central portion of the affected area of the skull parallels the increasing amount of new bone.

These findings are most convincing although it is difficult without speculation to explain the relationship between dilatation of blood channels and bone proliferation. Our present knowledge of osteogenesis is limited to hypothetical considerations many without actual facts to support them. It is evident that had this dilatation of blood channel progressed more rapidly it would have resulted in mere destruction of bone but the extremely slow dilatation of the channels is most likely a process stimulating proliferation of bone whether it be by keeping the periosteum under increased tension because of venous stasis in the bone or through other unknown factors.

Advancing in the microscopical study from the periphery to the center one can follow the varying extent of infiltration of the overlying skull by tumor cells. First they appear in the diploic. Because of less resistance the cells spread here farther than in the adjoining external or internal tables (Fig. 2). Soon however tumor cells are noticed in the internal table and in the new bone about it. Finally in an area nearer the center the tumor cells are seen in the external table and in the adjoining new bone. After the tumor cells have made their way through the external table they spread through the soft coverings of the skull far more extensively than in the external table (Fig. 3). The tumor cells show a tendency to spread along lines of lesser resistance thus aside from filling the enlarged Haversian canal and dilated blood space they spread between the bony lamellae frequently emphasizing by this the separate layers of the newly formed bone. This passiveness of the tumor cells is also well seen in the infiltration of the soft tissues covering the skull after the tumor cell have perforated the bone they spread along

fascial planes and through arcolar connective tissue spaces compressing rather than destroying the surrounding normal structures. In view of this passiveness of the tumor cells it is preferable in speaking of meningioma to use infiltrate rather than invade.

The passiveness of the tumor cells does not preclude their ability to destroy bone after they have spread throughout its canals and lacunae. Histological studies show various phases in this bone destruction which viewed largely does not differ from destruction of bone by any other mesoblastic tumor spreading in it. The tendency of the tumor cells to multiply though enclosed in bony chambers leads to gradual pressure absorption of the walls of these chambers. Occasionally one encounters an active bone destruction which is accomplished through the assistance of normal osteoclasts. This active destruction however is rare. The dense bone of the tables proper is extremely resistant to destruction so that even in the advanced cases of cranial changes one may easily distinguish the outlines of both tables microscopically as well as in the radiogram of a slice of the removed bone flap (Fig 5). Destruction of the new formed bone on the intracranial side of the skull may lead to irregular jagged excrescences of bone surrounded by soft tumor (Fig 4).

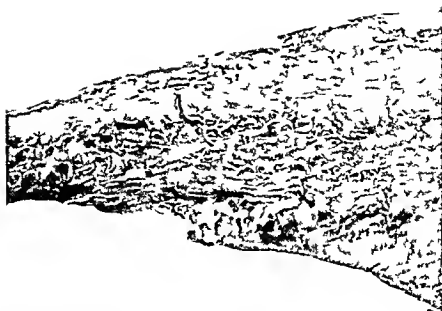
The arrangement of the new formed bone is of some interest. The most frequent arrangement is in layers parallel to the surface of the skull. This arrangement of bone is readily understood if one considers the periosteum responsible for its production. The parallel striation of the new formed bone can be appreciated only in microscopical studies while in the radiogram they cannot be distinguished because they coalesce in the shadow. Occasionally the new bone is arranged in spicules perpendicular to the surfaces of the skull. On the cut section of the gross specimen one sees numerous dense glistening striæ which are closely aggregated at their base on the bone surface and arranged perpendicularly to the external and internal table of the skull. Topographic microscopical studies show bands of connective tissue which divide the proliferated new bone into radiating columns by dipping into it at irregular intervals. Blood vessels fre-



Fig 1. Roentgen am of a bone flap overlying a meningioma. Note the widely dilated dilaic veins in the periphery.

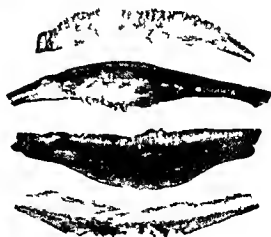
quently accompany these bands and between them numerous dilaic spicules of bone are seen running perpendicularly to the tables of the skull. It appears as though the course of the blood vessels and bands predetermines the course of the bony spicules. Phemister expressed an opinion that the new formed bone is always arranged to support the tumor. Histological evidence does not support this view. When present the perpendicular arrangement of the bony spicules is found also in the periphery where no infiltration of tumor cells is seen while in the central portion of the affected bone area where tumor is seen in abundance bony spicules are less abundant (Fig 5).

The degree of bone proliferation and the amount of new formed bone vary greatly with each case. Cushing pointed out the fact that the proliferation of new bone is greatest in the flat variety of meningioma—the so called meningioma *en plaque*. Three cases of meningioma *en plaque* in the present series support this observation. The dilatation of vascular channels in these three cases extended over a much wider area than in the ordinary spherical meningioma. Microscopically the infiltration of bone by tumor cells was really negligent extending over a smaller area and permeating only the intracranial portion of the bone. This wider and more extensive dilatation of the blood channels of the overlying skull coupled

[illegible]

with the negligent infiltration of the bone by tumour cells probably is an important factor in intensive proliferation of bone.

there is any relationship between the chromatin change and the cellularity of the underlying tumor. Histological evidence points against such a relationship. Extremely cellular tu-



l z Th t m ll h m d th ay th h th
k ll The t m f l th h th ft t
the k ll m t l th th t n l t bl 4

I 4 K t m f th l f k ll m
 k m t f Th v h w j l es f k l
 lo l lb ft m unt l f e f k l



FIG. 5. Roentgenogram of a slice 1 centimeter thick of the skull overlying a meningioma. Notwithstanding the extensive destruction of bone the outlines of both tables are shown well. In the central portion of the affected line area where tumor was present in abundance bony spicules are scarce.

more are seen where bone proliferation is strikingly great but fibrous relatively acellular tumors are encountered along with extensive destruction of the overlying cranial boss.

An interesting relationship is that between the proliferative cranial changes and the patient's age. It seems that the age of the patient is of some importance in all pathological conditions having osteogenesis as one of the main features; osteogenesis is better expressed in patients who are below or just at the age of completion of growth of the skeleton. It is of course hardly possible to draw reliable conclusions from so small a series of cases as the present one. However the proliferation of bone was definitely more in evidence in all patients below thirty years of age that is in five cases out of the ten studied.

The clinical incidence of cranial changes in meningioma has been placed by Cushing at not less than 25 per cent of all cases. The fact that such changes were present in all ten cases of the present series is inconclusive since these cases were chosen and not taken at random. A reliable figure as to the clinical incidence will be impossible to give as long as the skull overlying meningioma is not studied radiologically and histologically in every case.

SUMMARY AND CONCLUSIONS

To draw reliable conclusions from microscopical evidence of the cranial changes as

sociated with meningioma one must study sections from the entire overlying portion of the skull and not merely from the central most changed portion.

Proliferation of bone precedes the infiltration of the skull by tumor cells. This proliferation follows on the heel of a local dilatation of the vascular channels in the skull; it is probably a result of a defensive reaction of the bone to this slow progressing dilatation of the blood vessels.

Infiltration of the bone by tumor cells takes place subsequent to the commencement of the formation of new bone; it leads to bone destruction and occasionally to complete perforation of the skull.

NOTE.—It is a pleasure to acknowledge my indebtedness to Dr. J. G. Greenfield, pathologist of the National Hospital, Queen Square, London, for his permission to make use of the material on which this contribution is based.

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A STUDY OF THE PERIPHERAL ARTERIAL CIRCULATION IN
ARTERIOSCLEROSIS AND CANCER

WILLIAM C. EMERSON, M.D.

STANFORD I. WALKIN, M.D.

F. M. H. I. M. I. I. R. I. I. y. f. b. U. y. I. R. h. S. c. h. I. M. I. I. I. I. y. R. h. N. A. I.

GANGLIOMA of the extremity is all too common an accompaniment of peripheral arterial disease. It is dependant upon the cutting down of the caliber both of the main arterial trunk and the anastomotic branches by an obliterating endarteritis or sclerosis.

This study was made to determine if possible the caliber and condition of the various arteries of legs amputated for gangrene.

In a series of even cases of amputation for gangrene of the feet we have been able to demonstrate loss of continuity and diminution in size and number of anastomoses of the distal vessels. In this small group the changes are extreme. Obviously this must have been so to have produced gangrene. It is remarkable (yet obvious) how wide pread and pronounced the change may be and yet cause no circulatory failure until it has cut off the blood stream from all side. The anastomoses open too more readily and they are peninsular of flesh and it were with restricted area from which they can receive anastomotic supply.

Frequently the peripheral vessels especially the popliteal, dorsalis pedis, arteries etc. are calcified and how abnormally irregular beaded pipe stems in X-ray film. Often this is indicated in index of the extent of the disease. In this study we have been amazed at the profound change present throughout the arterial system in the even legs which were dissected. It was much more extensive than was indicated in the film by the calcification of a few vessels. Of our extreme changes were expected in the gangrenous area which showed no very extensive calcification in the arterial wall. In the film made after injection of the arterial system with barium sulphate solution the general extent of the sclerotic process was very evident.

Although an attempt to show the arterial circulation during life have been reported the procedure is not without danger. This is

especially so if an irritative substance must be introduced into the channel of arteries already badly damaged. Many of the arteries dissected out after amputation showed recent sclerotic changes evidently tending rapidly toward destruction of the wall and occlusion. This type of lesion should dissuade one from using any but non irritative substances for any attempt at demonstration of circulation.

METHOD

Films taken previous to operation were studied for calcification of vessel wall to gain some idea of the extent of the arterio sclerotic process. The amputated leg were taken till warm from the operating room and the femoral artery was dissected free. An adapter for a record syringe was tied into the lumen of the artery. A thin suspension of barium sulphate in heparin, tepid normal saline into about 5 ounce of warm water or olive oil was injected with a syringe into the artery under considerable pressure. Blood vessels at the cut end of the limb were allowed to empty themselves of blood and crum until a full stream of the barium suspension issued from them. They were then clamped and tied off. The injection was continued until no more material could be forced in by hand pressure on the plunger of the syringe. By this time some of the kinetic vessels were injected and the extremity became quite pale though still warm. The artery was tied below the adapter.

X-ray films were now made in the usual position or at any convenient distance or position. The films shown here were taken 1/2 inch target film distance and a Buck's hypophosphite and green calcium chloride and.

The arteries were dissected out immediately following this while the leg was still warm. The inner diameter or the caliber of the artery was measured in millimeter by means of a calibrated Bore r. The measurement



Fig. 1 Lateral view of left leg and foot following barium injection of the arterial system immediately after amputation showing large gaps in the lumen of main vessels due to sclerotic changes and poor anastomotic network.

were obtained at the following points: Popliteal 3 centimeters above origin of anterior tibial; anterior tibial 1 centimeter below point of origin; posterior tibial 1 centimeter below point of origin; peroneal 1 centimeter below point of origin; peroneal at point of bifurcation from posterior tibial (Table I).

The arteries were also dissected out in the regions shown in the film to be defective and searched for clots. In all seven of the extremities studied here the defect has been found to be in the artery wall with partial or total occlusion as depicted in the films. At no point were clots found in any of the larger vessels. The finer vessels i.e. under 1.0 millimeter were not measured for this study chiefly because of their multiplicity.

The same points in the arteries mentioned above as nearly as possible were measured in millimeters with a micrometer directly on the X-ray film. This measurement as the film is made at the 25 inch distance and the vessels are only an inch or two from the film is distorted a small percentage at the most. As there is apt to be some change in diameter of



Fig. 2 Lateral view of left leg showing poor anastomotic circulation and five tortuous arteries with irregular lumina. Appearance of arteries in film borne out by dissection.

the vessel from the handling during dissection, cutting across for the insertion of the measuring rod etc., these measurements are also apt to be in error depending upon the amount of trauma and cooling etc. This might vary considerably from vessel to vessel. On the other hand a warm solution containing insoluble non-toxic barium sulphate injected under pressure should distend all the vessels of about the same caliber uniformly. Measurements therefore of the shadows of barium inside the vessels in the X-ray films should be comparable. If the amount of distortion is taken into consideration these measurements



Fig. 3 Anteroposterior view of left foot following barium injection showing poor vascular supply to all of the gangrene of the fifth toe, mummification of part of the fourth toe, and phalanges of the other toes.

TABLE I. COMPARATIVE MEASUREMENTS OF ARTERY CALIBER IN DIFFERENT FILMS

| | F I L M | | | A T T E | | P E R I | | P E R I | | I N J E C T I | |
|-------|---------|---|---|---------|-----|---------|-----|---------|-----|---------------|-----|
| | N | I | I | N | K I | N | R I | N | R I | N | R I |
| FB | 1 | 4 | 3 | | 3 | | | | 0 | | |
| FI | | | | 6 | 0 | | 1 | | | | |
| I | | 4 | 5 | | | 3 | | | | | |
| FM | | | | 3 | | | | N | I | | |
| FI | | | | | | | | | | | |
| N I I | | | | 4 | 3 | N | 5 | 0 | 1 | | |
| FM | | | 3 | | | | | | | 5 | |

in all films due to the actual diameter of the peripheral artery in given situation.

DISCUSSION

These measurements are made upon an abnormal vessel and how we think though we have a normal one to compare them with a generalized and irregular diminution in caliber (Table I). This of course is to be expected in cases with such advanced sclerosis of the vessel that gangrene is impending. Injections of opaque substance (potassium bichromate) into the blood vessel of extremities have been tried fairly successfully but they are rather lingering. Such a demonstration of the vessel before operation would be of great determining amputation level.

Injection of the film of the injected arterial system in the case how much a wide peripheral involvement of the arteries by the arteriosclerosis that amputation in the mid thigh is entirely justified. This was borne out by the situation which disclosed extreme and well pronounced endarteritis. It is rather a common experience especially in diabetes to have local amputation for gangrene fail to heal. Subsequent higher amputations often remain unhealed until a mid thigh amputation is done. Often in extreme cases this will fail to heal if the process is generalized.

It is rather easy to see why this is so. The blood vessels were probably supplying almost the minimum requirement for local metabolism under a chronic condition. Any traumatic action or other stimulant of repair brings about a reaction which cannot be supported by the blood supply so healing does

not occur. The reaction often brings up the end arteritis with the result that the circulation is shut off and the gangrene extends upward from the film and direction of the case even in cases with generalized arterio sclerosis and gangrene of an extremity it is evident that amputation should always be performed high enough to reach large vessels probably still giving a good blood supply and with a fairly rich bed of anastomosis. This conforms with the experience that mid thigh amputation gives the most satisfactory result if injury is to be obtained in the extreme cases.

CONCLUSIONS

Injection of X-ray films of the extremities in cases of arterio sclerotic gangrene do not often indicate by the calcification in the arteries the profound changes and the general involvement of the arterial system by the arterio sclerosis and endarteritis.

Injection of film made of amputated limbs in which the arterial system was injected with barium shows this general change clearly.

Measurements with calibrated rule of the inside caliber of six major arteries in the leg agree closely with those made upon X-ray films following injection of the arteries with barium and how the generalized and irregular decrease in size.

The future use of opaque media injected into peripheral vessels will make it possible to measure these vessels accurately and determine the extent of their lesion. The opaque substance must be harmless, non-irritant to the vessel wall and readily excreted from the body.

CLINICAL SURGERY

FROM THE SURGICAL CLINIC OF THE MOUNTAIN HOSPITAL

OPERAITIVE TREATMENT OF HYDATID CYSTS OF THE LIVER

HAROLD DWYER, F.R.C.S. (LOND.) MELBOURNE, AUSTRALIA

ALTHOUGH hydatid disease is most commonly met with in Australia, New Zealand and South America, sporadic cases occur in all parts of the world. In about 70 per cent of all cases the liver is involved. The following distinct types of lesion are here found: (1) Simple univesicular cysts which are usually found in children or young adults. (2) Multivesicular cysts or cysts containing daughter cysts. These are often of a large size with an irregular thickened adventitia, are often bile stained and typical of the disease in the adult. (3) Complicated cysts which are usually multivesicular, the common complications being rupture into the biliary channels, suppuration or rupture into the abdominal or thoracic cavities.

PRE-OPERATIVE ROUTINE

In about 75 per cent of cases the cyst occurs on or near the inferior surface of one of the hepatic lobes, a painless tumor being palpable in the upper part of the abdomen. The others occupy the subdiaphragmatic zones where they usually remain latent until they are of a large size often manifesting themselves only by the onset of one of the already mentioned complications. It is therefore essential that a roentgenogram of the diaphragmatic area be taken in order to detect any distortion or elevation that may be present. Intrathoracic extension or the presence of an unsuspected pulmonary cyst may also be revealed. When it is remembered that more than one cyst is present in at least 60 per cent of cases the importance of a preliminary roentgenogram is realized. In addition the Cason intradermal test and the complement fixation reaction should be performed. Except for the intravenous exhibition of calcium chloride in those complicated cases with jaundice, no special pre-operative treatment is required.

THE OPERATION

Anæsthesia. As a rule there is no contra-indication to general anæsthesia except in the

rare cases of hepatobronchial fistula in which local anæsthesia with paravertebral nerve block is the method of choice. There seems to be no doubt that local anæsthesia carries with it some risk of anaphylactic shock which owing to the abolition of this peculiar state by general anæsthesia is absent when ether is administered. If for any reason local anæsthesia is used anaphylactic symptoms if they occur can be controlled by the intravenous injection of 5 minims of 1:1000 adrenalin.

The incision. This should be made so as to give the most direct access to the cyst, the position of which has been ascertained by clinical and radiographic methods. As a rule a vertical paramedian incision with splitting of the rectus muscle gives excellent access but at times Kocher's subcostal incision is more suitable. For cysts of the superior quadrants of the liver a transthoracic approach with rib resection is essential. Since in these cases it is all important to avoid if possible opening the pleural cavity, the incision should therefore be made as low down and as far forward as convenient. In some cases however owing to non obliteration of the phrenicocostal angle the pleural cavity is opened. Suture of the diaphragm to the thoracic parietes may be desirable but this is difficult to carry out effectively and owing to the loss of support when the subjacent cyst is evacuated the sutures often pull through thus producing a sucking wound with its attendant risks. In non-urgent cases it is advisable to paint the serous surfaces with 5 per cent iodine and carry out tamponage with iodized gauze to cause the formation of adhesions. Two or three weeks later incision and evacuation of the cyst can be carried out through these adhesions without risk of pleural soiling or pneumothorax.

Exploration. After the peritoneum has been opened wide retraction should be practiced there being many disadvantages in the lack of exposure obtained through the small incisions.

thetia is used may give rise to severe or fatal anaphylaxis while the use of general anæsthesia may cause less severe delayed, postoperative anaphylactic symptoms. It is therefore important to prevent contamination of the field with hydatid fluid although it is often impossible to avoid it completely.

If active hydatid elements are shed into the operative field, they may become implanted in the peritoneum or parietes where they grow and give rise to secondary cysts which manifest themselves only after some years of growth. Neglect to take definite precautions against such contamination was common in the past so that as a result the older records contain many reports of cases of postoperative secondary cysts of the parietes and abdominal cavity.

In thick walled cysts it is sometimes possible by means of a fine curved atraumatic needle to insert guys of fine chromic gut so as to give the assistant control of the cyst. In thin walled cysts this maneuver often causes puncture and collapse of the elastic laminated membrane of the parasite. As a result the high intracystic pressure may force fluid or even scoobes through the needle punctures with contamination of wound.

In any doubtful case the guys should be dispensed with until a later stage the cyst being kept in the wound by the pressure of the assistant's hands on the abdomen below. The cyst should then be punctured with a large hollow needle and the fluid conveyed away from the operation field by tubing. I have found a special two way needle and syringe of great value in this connection (Fig. 1).

The needle is inserted into the most accessible part of the cyst wall. As a rule this is covered by peritoneum only but sometimes a layer of hepatic tissue must be traversed. Hydatid fluid escapes through a rubber tube into a dish. The character of the flow should be noted. In the case of a univesicular cyst a large quantity of fluid escapes in a continuous stream before the needle becomes blocked with the collapsing mother cyst. The block can readily be removed with a stylet. If daughter cysts are present the flow lasts only a short time that is until the particular daughter cyst punctured is evacuated. If the needle is pushed further in another small quantity may be obtained. The color and nature of the fluid also may give important information as to the state of the cyst contents. After as much fluid as is practicable has been run off pure commercial formalin is injected from the previously charged syringe without removing the needle. Enough formalin should be injected to

make with the fluid remaining in the cyst at least 1:15 per cent solution. In the case of a cyst 10 centimeters in diameter I inject 75 cubic centimeters allowing the solution to act for at least 4 minutes in order that any free hydatid elements may be killed. During the delay the packs should be rearranged guys placed in the adventitia and the large bore (15 millimeters) tube of the electric or water pump placed ready in lower angle of wound (Fig. 2).

The formalin can have little effect on intact daughter cysts but it is worth while to use it, even when multivesicular cysts are present in order to fix any scoobes set free by puncture or manipulation. After the formalin has been allowed to act the adventitia may be boldly opened the assistant either by means of the guys or by pressure on the abdomen below keeping the cyst wall in contact with the packs. The wide bore tube connected with a water or electric pump is then used to evacuate any fluid or debris. With sufficient negative pressure even large daughter cysts can be removed in this way although in some cases the contents are so thick that the pump may prove ineffectual. In such cases an ordinary tablespoon is very useful. Whatever method is adopted complete evacuation of such cysts is often a time consuming procedure. In the case of univesicular cysts the large thick walled mother cyst can usually be delivered intact and by means of the pump all fluid can be readily removed practically precluding any contamination of the area. Great care must be taken to evacuate all debris. Pouches and diverticula should be looked for and the inside of the adventitia either swabbed with dry gauze or irrigated with saline. After this the cavity should be swabbed with 4 per cent formalin or 90 per cent alcohol the excess being removed with dry gauze. No attempt should ever be made to remove the thick fibrous adventitia completely. Not only is this unnecessary but owing to the intimate connection between the adventitia and the hepatic connective tissue and the frequent presence of large veins such an ill advised attempt is fraught with great danger and may be followed by a fatal result. In very large cysts partial removal of the extrahepatic portion of the adventitia may however be carried out to facilitate closure.

Treatment of the cavity. The ideal procedure is to close the cavity and the abdominal incision without drainage. However this depends on the pathological state present.

1. In the case of clean simple cysts when the inner wall of the adventitia is smooth and when

little if any bile enters the cavity should be filled with sterile normal saline and closed with out drainage (Fig 3). The saline acts as a buffer against the entry of bile obviates a post operative pneumocyst dilutes any bile that may leak in and as it slowly absorbed allows gradual contraction of the adventitious capsule provided a crisis is maintained this method followed by a rapid convalescence and leaves an intact abdominal wall.

2 If the cyst contains daughter cysts it may often be safely treated in the same way although owing to the difficulty of complete evacuation and the frequency of gross biliary leakage the method is not so universally applicable nor so safe. In any cases in which the surgeon is doubtful as to the completeness of evacuation or when bile enters freely it is advisable (a) to leave one of the sutures in the adventitia long and to bring it out through the incision (b) to place a drainage tube down to the suture line or (c) to suture the adventitia tightly to the peritoneal suture line. These are safeguards against leakage into the peritoneal cavity and if the pressure in the cavity rises because of infection provide an efficient and safe guide to the sutured cyst in order to institute drainage.

3 If the cyst is infected a phenomenon which is usually associated with engorgement of the outer surface deposit of recent lympho-mental adhesions and turbid or foul smelling content or if the surgeon is uncertain as to the wisdom of closure for reasons such as difficulty of access biliary contamination multiloculation etc it is advisable to close the adventitia partially and provide drainage through a dependent part. The rubber drainage tube should have a wide bore should be provided with lateral openings and if possible the omentum should be brought into position around it. Such a method is essentially safe and although some successful cases of evacuation and closure without drainage of these types of cyst have been recorded I believe that this procedure carries with it an unjustifiable risk. Hence I advocate drainage in all such cases. In suppurative case it is obvious that if transthoracic drainage is undertaken every effort should be made by proper siting of the incision or by means of a two stage operation to prevent pleural contamination an event which often leads to a pyopneumothorax.

4 Calcareous change in the adventitia of old standing cyst is not uncommon and presents some problems. The change is as a rule patchy but in rare cases the whole adventitia may be

converted into a thick rigid calcareous envelope. The parasite in such cases is usually dead and such cysts are usually quiescent operative interference is not often necessary. Operation should always be avoided if possible because of technical difficulties and because infection if once introduced invariably leads to the formation of a persistent sinus with a foul smelling discharge. Sometimes however usually because of a low grade infection such cysts require operation. The operation should take the form of evacuation treatment with alcohol attempted suture of the adventitia and closure of the parietal wound with a tube down to the suture line only. In this way it may be possible to avoid the introduction of infection or to control a quiescent infection without the distressing sequela of a chronic sinus. The methods of dealing with the cyst cavity are schematically shown in Figure 4.

Space will not permit any detailed consideration of the other types of complicated cyst. Each carries with it numerous problems of its own which I have discussed elsewhere (1). The outstanding principles of treatment of some of them however may be summarized as follows.

1 *Rupture of the cyst into the biliary passages.* Clinically this complication is characterized by intermittent or persistent jaundice biliary colic hepatic tenderness the passage of hydatid debris in the stools and not infrequently by symptoms of suppurative cholangitis. As a result the diagnosis of complicated cholelithiasis is often made and exploration to this end carried out. When no gall stones are found further search may reveal a hydatid cyst which should be dealt with by drainage. At the same time the common bile duct should be carefully examined. If jaundice is present it may be presumed that the duct contains hydatid debris or daughter cysts and that infection of the biliary passages is present. Drainage of the common duct should then be instituted.

2 *Rupture into the peritoneal cavity.* This may occur either spontaneously or following varying degrees of trauma. It is usually characterized by some degree of peritoneal shock simulating other acute upper abdominal lesions and is often accompanied by anaphylactic symptoms in the form of urticaria erythema dyspnoea etc. It is obvious that depending on the state of the cyst as regards infection biliary contamination etc there are many possible sequelae. At operation fluid and debris should be removed from the abdominal cavity as completely as possible particular attention being given to the paracolic sulci and peritoneal fossae. The under surfaces of

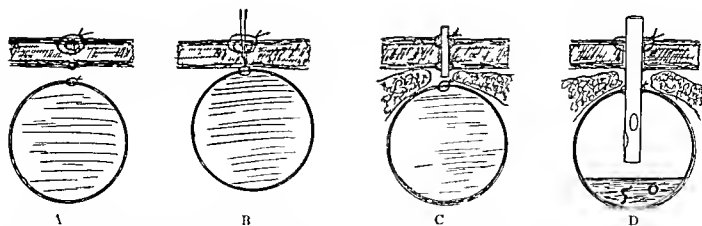


Fig 4 Schematic representation of the various methods of dealing with the cavity of a hepatic hydatid cyst after evacuation A Filling with saline and closure with sutures B Filling with saline closure and drainage C Filling with saline closure and drainage with a drain tube D Open drainage with a drain tube

1. 1. 1. 1. One suture is brought out C Filling with saline closure and the placing of a drain down to the bottom of the cyst D The omentum in position

the liver should be explored for the leaking cyst so that it may be evacuated and drained. It is of course probable that the patient will develop multiple secondary abdominal cysts some years later and he should be warned of the necessity of keeping under observation at least 10 years.

3. *Rupture into the pleura or the bronchi* is a comparatively rare complication of subdiaphragmatic cysts but many diverse pathological pictures are possible. Thus empyema, cholethorax, cholepyothorax, cholepyopneumothorax or simple hepatobronchial fistula with bile stained expectoration may occur. Unless the surgeon is aware of the vagaries of hydatid disease in this situation the true state of affairs may be realized only at operation. Such cases demand dependent drainage of the subdiaphragmatic cyst and this may sometimes be undertaken at the time of drainage of the commonly associated empyema or more frequently at a second operation.

POSTOPERATIVE COMPLICATIONS

1. *Anaphylactic symptoms* Owing to the absorption of hydatid fluid at operation there may be anaphylactic symptoms even after general anesthesia although they are usually delayed for some days. These take the form of vague pyrexia, dyspnoea, asthmatic attacks, cutaneous eruptions etc. but as a rule are transient and of very little significance.

2. *Postoperative pyrexia* If this is transitory it is usually due to simple postoperative reaction or to anaphylactic effects. If it persists or reaches any height it must be regarded as serious. In the case of cysts which have been closed it often means the onset of infection in the cavity probably from entry of infected bile or recrudescence of a quiescent infection. It may

also be due to leakage through the suture line with resulting localized peritonitis. In all such cases one should not hesitate to reopen the wound and to institute drainage.

Following the drainage of a suspicious hydatid a high temperature usually means the onset of infection the organism finding in the hydatid debris which is often inadvertently left an excellent pabulum for growth. In such cases care must be taken that the tube is not blocked by membrane and that pus is not allowed to remain under tension. In suppurating cysts drainage is usually free and in some cases a persistent high postoperative temperature with severe toxæmia is noted. Many of these infections are anaerobic. It would seem that open drainage brings about aerobic conditions which allow of rapid growth of streptococci. The latter are generally found exclusively in the discharge after a few days. The fact that the cyst wall and the wound of the soft tissues become infected with streptococci of a virulent type accounts for the severe toxæmia. Other causes of pyrexia are the onset of infective complications as subphrenic abscess, localized peritoneal collections, empyema, extension into the hepatic tissues or suppurative cholangitis.

3. Leakage into the peritoneal cavity through the suture line of a closed cyst is a well known postoperative complication and should be carefully watched for in all cases. It may give rise to a mild or severe localized peritonitis with pain, tenderness, rigidity and toxæmia and will necessitate reoperation and drainage. Occasionally bile enters the peritoneum freely and a biliary effusion or choleperitoneum is produced. This may be latent and give rise to few symptoms but as a rule the presence of a low grade infection causes suppuration and necessitates drainage.

4 Deep persistent jaundice accompanied by rigors and sweats may occur especially with suppurating cysts or with cysts which have ruptured into the biliary passages. Such cases have an exceedingly grave prognosis the institution of common duct drainage being as a rule the only measure of value.

5 Intermittent drainage is sometimes a problem which may be due to the pocketing of a large cyst or the blocking of the tube by hydatid membrane or slough. We should guard against this by not shortening the tube too soon by irrigation method and by careful exploration of the draining tract. In some cases large sloughs derived from the avascular adventitia may separate with a profuse discharge. Such sloughs may be several square inches in area and their separation may be accompanied by secondary hemorrhage which is however rarely fatal. Persistent drainage over a period of months is not uncommon and may be due to a great variety of causes. Thus the pocketing of discharge due to irregular collapse of a large cyst, cicatrization of the adventitia, the formation of a thick granulating cavity wall, the formation of soft calculi in the draining tract or non dependent drainage may all be factors. In some cases the discharge is particularly foul and owing to the persistence of toxic manifestations further operation may be required. Sometimes profuse persistent discharge of bile occurs. Although this usually ceases as contraction occurs it is important to bear in mind that there may be another cyst causing pressure on the ducts or the ducts may be partially blocked by hydatid debris. In such cases the administration of ox bile by mouth is of benefit. In persistent cases a further operation to correct the condition must be done.

6 Secondary implantation cysts may occur in the peritoneum or in the abdominal wall. These cysts are derived from scolices or brood capsules which split at operation and manifest themselves at a period varying from 1 to 10 years after operation. In the past the frequency of this complication has not been sufficiently recognized and until hydatid cysts are treated with the same respect as an infected focus they will continue to be relatively common. The method of accurate protective packing for malimination and prevention of leakage already indicated are at the present time the best means at our disposal to obviate this complication.

Recrudescence of symptoms at a later date is sometimes due to the presence of a residual cyst. These may be readily overlooked at the primary operation unless careful exploration is

carried out. Occasionally the relief of pressure occasioned by the evacuation of a superficially placed cyst allows a deeper cyst to extend forward and produces a swelling in the original site many months later. At other times the residual cyst becomes infected and somewhat puzzling symptoms appear at varying time after operation. It is in the detection of such cysts that I have found the complement fixation test elaborated by N. H. Fairley () invaluable.

8 Incisional hernia and intestinal obstruction from adhesions are rare postoperative sequelae.

PROGNOSIS

In uncomplicated cysts the results of the treatment which I have outlined are excellent the mortality is negligible and convalescence uneventful in the majority of cases. In complicated cases particularly in the presence of suppurative the mortality is higher and in nearly all cases is due to the spreading of the infective process. In suppurative cases the mortality approaches 50 per cent while in intrapleural or intravisceral ruptures it is approximately 50 per cent. It is the frequency of complication—rupture, infection or implantations—which often makes hydatid disease both as to morbidity and mortality so serious a surgical problem.

In determining whether a patient is cured or not we find the complement fixation test of great value. After complete evacuation of a small cyst the amount of complement fixed falls rapidly and if it persists to the extent of fixation minimum hæmolytic doses of complement after 1 month it is very probable that a residual cyst is present. The test should always be performed quantitatively and the serum tested regularly every 3 months after operation if an accurate prognosis is desired.

CONCLUSION

In this short survey of the operative treatment of hepatic hydatids it has been possible only to touch on some aspects of this interesting disease. Surgeons working in hydatid countries are constantly meeting with diverse clinical and pathological pictures some of which tax their diagnostic powers and surgical ability to the full. If I have succeeded in throwing light on some of these problems this article will have achieved its purpose.

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FROM UROLOGIC SERVICE MICHAEL REESL HOSPITAL

A SIMPLIFIED TECHNIQUE FOR REMOVAL OF CALCULI IN THE PELVIC PORTION OF THE URETER

DANIEL N EISENDRATH MD FACS CHICAGO

THE removal of impacted ureteral calculi located between the point where the ureter crosses the iliac vessels and the point of entrance into the bladder, is often a very difficult procedure. This is due to a number of factors.

1 It is difficult to identify the ureter because it lies in most intimate relation to the peritoneum lining the iliac fossa and true pelvis. Unless the exposure be an adequate one, much valuable time is lost because of the retraction of the ureter inward with the peritoneum.

In some cases there is such a degree of inflection of the periureteral sheath that rather dense adhesions to the iliac vessels and peritoneum have formed. We were obliged to expose the juxtavesical portion of the ureter intraperitoneally in one case in which an abdominal hysterectomy had been followed by the formation of such dense adhesions between the ureter, iliac vessels and peritoneum as to render mobilization of the pelvic ureter a hazardous procedure by the most commonly employed extraperitoneal route.

One should never attempt to separate forcibly an adherent ureter from the iliac vessels lest an uncontrollable hæmorrhage result from injury of some large arterial or venous trunk. Opening of the peritoneal cavity is unavoidable at times especially in the female during mobilization of the pelvic ureter. This has occurred in several of our cases but the opening was immediately closed with fine chromic (No. 00) catgut.

In all operations on the pelvic ureter the patient should be placed in extreme Trendelenburg position. No special preparation of the operative field is necessary. Some operators prefer a median incision for exposure of the pelvic portion of the ureter while others employ a pararectal incision displacing the peritoneum toward the midline of the body so as to avoid opening the peritoneum. We prefer an incision which runs parallel to the outer half of Poupart's ligament and then continues almost vertically upward when it reaches the anterior superior spine of the ilium. The fibers of the external oblique aponeurosis are separated and then the internal oblique and transversalis muscles are divided as close to the outer border of the rectus muscle as possible. Upon reaching the peritoneum lining the iliac

fossa it is displaced inward with the aid of a gauze sponge until the iliac vessels are to be seen. The most difficult portion of the technique at this stage is the identification of the ureter. Since we have discontinued the pararectal or muscle splitting incision and have adopted the one giving a much wider exposure we have been able to identify the ureter far more rapidly. Usually the ureter is retracted mesially by the assistant and easily overlooked. If one begins to look for the ureter proximal to the point at which it crosses the iliac vessels (Fig. 1) it is more readily identified than if one searches for it at a point in the true pelvis. As soon as the ureter has been identified it is separated from the peritoneum lining the iliac vessels by a form of spreading dissection using blunt pointed curved scissors. As soon as the ureter has been completely separated in this manner we place a temporary sling or loop of catgut around the entire ureter so that it can be drawn close to the more superficial portions of the operative field. We then proceed to insert a traction suture of fine catgut (No. 00) through the wall of the ureter just proximal to the point at which it crosses the iliac vessels (Fig. 1). An incision is then made with a very small scalpel (similar to those employed for eye operations) so as to open the lumen of the ureter.

The displacement inward of the peritoneum is now continued in a distal direction until the entire pelvic portion of the ureter is exposed (Fig. 2). An ordinary ureteral catheter is introduced in a distal direction through the opening previously made (Fig. 1) in the iliac portion of the ureter. This will yield valuable information as to the location of the impacted calculus and as to the degree of thickening of the ureteral wall opposite or below such an obstruction.

We do not propose to enter into a discussion as to whether calculi especially those impacted in the pelvic portion of the ureter are secondary to stricture formation here or whether the stricture is secondary to prolonged impaction of a calculus. It is of debatable origin. It is our opinion that one is as common as the other and this must be borne in mind in the postoperative care after ureterotomy for calculi which it has been either impossible to deliver by non operative methods

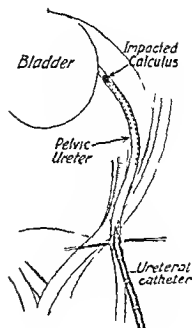
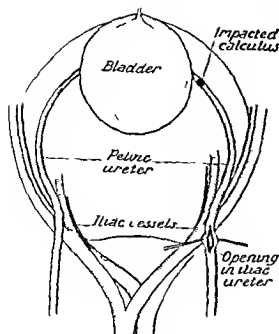


Fig. 4. Showing the method by which the ureter is opened directly over an impacted calculus. In (N. 00) catgut inserted just distal to the point where the ureter enters the bladder as shown in Figure 3. This fixes the juxtavesical portion of the ureter in such a manner that a second set of

Fig. 5. Illustration of the method by which the ureter is opened directly over an impacted calculus. In (N. 00) catgut inserted just distal to the point where the ureter enters the bladder as shown in Figure 3. This fixes the juxtavesical portion of the ureter in such a manner that a second set of

er in which the presence of anuria and pyelonephritis served as indications for operative interference.

On account of the outward curve which the ureter follows after crossing the iliac vessels it is very difficult in many cases to obtain adequate fixation of the ureter so as to incise directly over an impacted calculus. In order to obtain such fixation it is desirable to convert the outward curve into a straight line. We have been able to do this by inserting a series of traction sutures similar to those employed in opening the ureter in its iliac portion as shown in Figure 1. The first set of these traction sutures is introduced about midway between the iliac vessels and the point where the ureter enters the bladder as shown in Figure 3. This fixes the juxtavesical portion of the ureter in such a manner that a second set of (Fig. 4) similarly inserted traction sutures of fine (size No. 00 or No. 000) catgut inserted just proximal or opposite to the impacted calculus enables the operator to make a small incision directly over the calculus under guidance of the eye. Such a small incision made in the long axis of the ureter is indispensable if one wishes to avoid a postoperative stricture which often occurs if the ureter is opened by sense of touch alone. After removal of the calculus we pass a four-sided ureteral catheter (size 6) through the

iliac ureterotomy incision (Fig. 5) in both a proximal (up to renal pelvis) and distal (into the bladder) direction. While this catheter is in place the segment of ureter from which the calculus has been removed is carefully palpated in order to obtain information as to any decrease in its lumen or thickening of its wall indicative of stricture formation.

No attempt is made to close the incision in the pelvic ureter from which the calculus has been removed. A strip of drainage material known as Penrose sacking, i. e. a soft rubber drain made of the same material is used by dentists and called rubber dam is placed opposite the opening in the pelvic ureter and allowed to come to the surface at the lower end of the abdominal incision.

A stiff ordinary rubber tube should never be used in these cases because it may give rise to pressure necrosis of the iliac vessel with which it lies in contact. The iliac ureterotomy incision (Fig. 1) is closed with one or two interrupted sutures of fine chromic gut.

Care must be exercised not to enter the lumen of the ureter because of the danger that the chromic catgut may act as the nucleus of a future calculus. The soft rubber drain is left in situ for at least 10 days. Urine usually ceases for 5 or 6 days but this will cease promptly if no obstruction

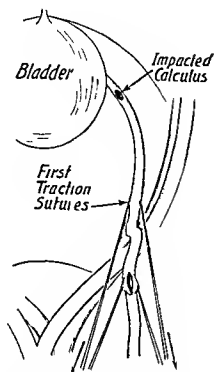


Fig. 3 First set of traction sutures inserted just below iliac vessels through wall of pelvic portion of ureter. Note disappearance of outward curve of ureter.

in the form of a stricture or overlooked calculus exists. The abdominal incision is closed layer by layer after a rubber drain has been inserted through its upper angle so as to drain any secretions which might collect in the iliac fossa.

The immediate complications following a ureterotomy in which the described technique is employed are the same as those following any operation on the kidney or ureter.¹ One must be constantly on the lookout for reflex intestinal paresis (renal ileus), acute gastric dilatation or anuria if an obstructing calculus has been overlooked in the opposite ureter or kidney.

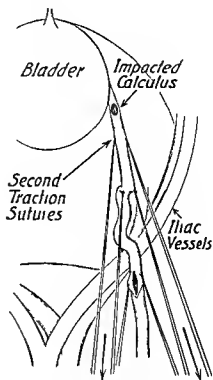


Fig. 4 A second more distally inserted set of traction sutures enable one to fix the ureter and corrects completely its outward curvature. A third set of these temporary sutures at the level of the impacted calculus is rarely necessary. One can now make an incision directly over the calculus under guidance of the eye.

Of late complications two deserve special mention, viz. stricture formation and urinary fistula. Every patient who has had a ureterotomy for impacted calculus should be examined as soon as feasible for stricture. Dilatation should be done for such a narrowing at regular intervals, possibly once a month, in order to forestall the reformation of a calculus at the site of the stricture or proximal to it. Fistula formation is rare at present and is usually due to stricture formation or to an overlooked calculus which is located distal to the incision which had been made for the previous ureterotomy.

A SIMPLIFIED TECHNIQUE FOR ABDOMINAL PANHYSTERECTOMY

EDWARD H. RICHARDSON, M.D., F.A.C.S., BALTIMORE
 Chief of Gynecological Department, Johns Hopkins University

COMPLIANT removal of the uterus by the abdominal route according to any of the procedures hitherto described with which I am familiar has not always proved either an easy or wholly satisfactory operation in my hand. Moreover, my observation of the work of a number of highly trained pelvic surgeons during the past 20 years together with the verbal testimony of others convinces me that I am not alone in this experience. I have witnessed one death on the operating table from uncontrollable hemorrhage which occurred while an experienced gynecologist possessing uncommon skill and mature surgical judgment was performing an abdominal panhysterectomy by means of a widely practiced technique for complicated pelvic disease. Repeatedly I have seen other men of merited renown as pelvic surgeons encounter annoyance and suffer embarrassment from obstinate venous bleeding which defied their resourcefulness during the execution of this operation. Occasionally too damage to the ureters has been observed. And in one instance it was my misfortune a few years ago to sustain a fatality from fulminating streptococcus peritonitis within 72 hours after an abdominal total extirpation of the uterus according to one of the best accredited plans.

Consequently during the past 4 years I have been endeavoring to perfect a technique which would be relatively simple, easy of execution and reduce to a minimum the three chief dangers, namely: (1) hemorrhage, (2) infection and (3) damage to the ureters. It is my belief that the operation presently to be described not only meets these major requirements but possesses in addition substantial minor advantage.

Since perfecting the operation I have made a reasonably comprehensive but not an exhaustive survey of the literature because I soon learned that an astonishingly large number of ingenious and meritorious modifications of standardized procedures have been described and it has not been possible for me to scrutinize all of them in detail. I have however examined a number of American, English, French and German text books and systems and have reviewed closely the procedures listed in various indices covering the earlier literature as well as that of the past decade without finding this plan described. If it later develops however that I have simply re-

discovered a technique which has been previously described by another who antedated me in working along this line I shall most willingly admit his priority of discovery and herewith dedicate this publication to his memory and to the advocacy of what I believe to be a good operation based upon sound surgical principles.

Of historical interest in connection with the presentation of this new panhysterectomy technique is the fact that this happens to be the semi-centennial anniversary of the first carefully planned total extirpation of the uterus by the abdominal route. On the 30th day of January, 1858, W. A. Freund first performed this operation for cancer of the uterus by a method which he had carefully worked out upon the cadaver. Moreover in the doing of it he made use of the posture which later was perfected by and is generally accredited to Trendelenburg.

Three years later in 1861 Dardenheuer who was familiar with Freund's cancer operation performed the first panhysterectomy by the abdominal route for a myomatous uterus.

In America Dr. Mary A. Dixon Jones on February 16, 1888, was the first to perform panhysterectomy for uterine fibroid. She first did an abdominal subtotal hysterectomy and then removed the cervix by way of the vagina.

In January, 1889, Dr. L. A. Stimson proposed and carried out his epoch-making contribution to hysterectomy, namely preliminary ligation of the ovarian and uterine vessels.

The operation of panhysterectomy was further popularized in the early years of its history through the work of W. M. Folk, James Eastman, G. M. Lideboldt, H. J. Boldt and I. Krug in America; Trendelenburg, Schauta, Chrobak and Lotz in Germany; F. B. Jessett and Thomas Keith in Great Britain; and L. Goulaud who was the first to perform it in France in 1891.

FOUR STANDARDIZED PLANS

Many ingenious and creditable modifications have been suggested from time to time since this early pioneer development of abdominal panhysterectomy until today at least four plans may be regarded as sufficiently well standardized and widely enough employed to be worthy of brief description. In all of these I shall omit that part

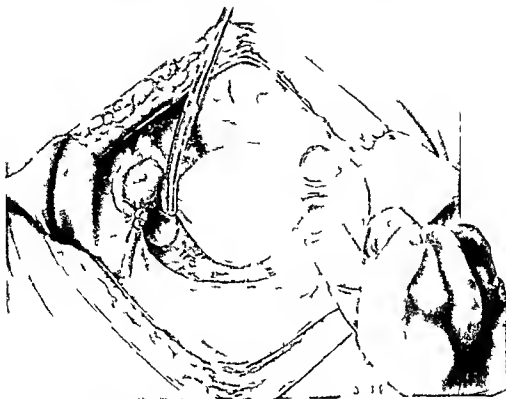


Fig 1 A transverse crescentic incision has been made along the upper margin of the vesico-uterine peritoneum and extended on each side up to the uterine attachment of the round ligament. On the left the index finger has perforated the broad ligament and is shown supporting the round ligament the fallopian tube and the utero-ovarian ligament. On the right these structures have been divided and securely ligated by a transfixing ligature.

of the technique which deals with the appendages since the variations employed in this part of the operation are irrelevant to the purposes of this communication.

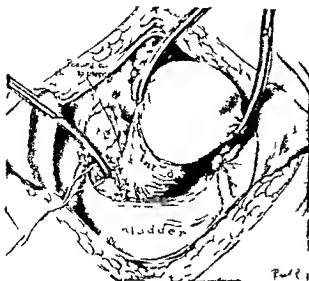
Plan 1 The uterine appendages having been appropriately dealt with the vesico-uterine peritoneum incised transversely the bladder freed and pushed well down and the broad ligaments laid open to expose the uterine vessels these are divided and ligated at the level of the internal os. Strong traction upward is now made upon the uterus while the operator using sharp dissection applied close to the cervix encircles it repeatedly each time at a lower level and divides all structures attached to it until the vaginal vault appears like the top of a tent. This is first opened at an advantageous point ballooning occurs and detachment is completed by a circular incision close to the cervix. An assistant follows the knife throughout the dissection applying a haemostat to each bleeding vessel and to the vaginal vault at strategic points as it is cut across. This procedure may be aptly described as the peeling out operation.

A modification of this plan is to core or ream the cervix out leaving a thin cylinder of cervical

tissue to which the supporting basal ligaments are attached.

Plan 2 The preliminary steps dealing with the appendages having been carried out the uterine vessels divided and ligated at the level of the internal os and the bladder separated from the cervix and carried down sufficiently to expose the anterior vaginal wall the operator now applies a stout clamp parallel and close to the cervix on either side embracing in its bite the parametrial tissues and basal portions of the broad ligaments quite down to the vaginal vault. These tissues are now divided. The vagina is opened anteriorly the cervix is grasped with a volsella and drawn forward into the pelvis while its vaginal attachment is divided laterally and behind with curved scissors or a knife.

Plan 3 This is the Doyen operation. Without preliminary disposal of the appendages the uterus is grasped with a heavy volsella and drawn strongly upward and forward over the symphysis. A blunt instrument is then introduced from below into the vagina by an assistant and carried well up into the posterior fornix. Cutting down upon this the operator opens the posterior vaginal wall. Through this opening the cervix is grasped



and drawn into the cul de sac. Its vaginal attachment is then divided laterally and anteriorly which permits it to be drawn sharply backward and upward. The bladder is separated from below as it comes into view and the uterine vessels and appendages are dealt with in sequence as they are approached.

Plan 4. One other plan with various minor modifications deserves special mention for two reasons: first, because it is championed by a number of excellent pelvic surgeons and undoubtedly is a better operation than any one of the three already mentioned, and second, because the original was devised by an American, Dr. J. E. Baldwin of Columbus, Ohio, and a description of the technique published in 1916. It differs essentially from the three plans outlined above in the fact that after the initial opening into the vagina is made, the index finger or a strong hook is introduced to serve as a guide and aid in completing the cervical detachment. Quite different also is the Baldwin method of suturing the round ligaments into the angles of the vagina and of closing the latter by a purse-string suture which further serves to invert its cut margin.

DEVELOPMENT OF AUTHOR'S TECHNIQUE

It cannot be denied that each of these plans as

well as a great many similar procedures that may justly be considered minor modifications of the type operations possess distinctive merit. Nevertheless, it can be justly contented that the extensibility of total hysterectomy cannot be satisfactorily executed by one of these three methods. But, there are less interesting in the large percentage of successes that can be achieved, more credit to the end results of a operative procedure than we are in the small number of technical difficulties, complications and failure that persistently crop up to mar our record. Such deficiencies in the general number are to be found recorded in every statistical study of the end results of hysterectomy that I have reviewed. It is hardly probable therefore that any experienced gynecologist will deny that by any technique in

ogue occasionally he finds the operative result of execution that hemorrhage is truly unbearable, some and occasionally embolism, even to the extent of jeopardizing one or both of the urgent necessities of its immediate center that

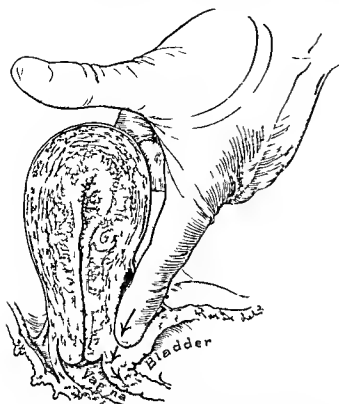


Fig. 4 A sagittal view with arrow indicating the direction and depth of the bladder dissection well below the level of the external os uteri. When the bladder is dropped well down the ureters are carried still further from the danger zone.

measures to combat or prevent postoperative shock are now and again required that actual damage to ureters still occurs and that in rare instances a fulminating streptococcus peritonitis brings a rapid exodus to his patient and profound mortification to himself. Such at least are my own convictions which are based not only upon personal experiences but also upon the observations and testimony of a number of exceptionally competent gynecologists with whom it has been my privilege either to be associated or intimately acquainted during the past 20 years.

Consequently I have given much thought to the development of a simplified technique for abdominal panhysterectomy which could reasonably be expected to reduce to a minimum these irritating and disastrous occurrences with the result that the operation now to be described has been gradually evolved. Five features of it were specifically designed to achieve this end, namely:

1. Complete separation of the cervix posteriorly as well as anteriorly below the level of the external os by means of blunt dissection applied according to a carefully devised anatomical plan and confined to its relatively avascular midsection. The specific purpose here is not only separation of the bladder and rectum but particularly

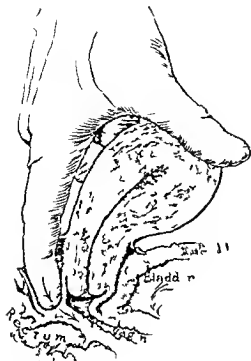


Fig. 5 The uterus is here shown lifted well upward and forward over the pubis. A transverse incision has been made through its posterior peritoneum 2 centimeter above the attachment of the uterosacral ligaments. The index finger is depicted applying blunt dissection to the relatively avascular midsection of the cervix and upper vagina for the purpose of separating the rectum well below the level of the external os uteri.

segregation of the loosely attached fan shaped lateral plexus of veins on each side into a narrow zone adjacent to the basal portion of the broad ligament in front and behind so that they may be included in a single clamp to be applied to the latter prior to its detachment. By this simple device the free bleeding usually encountered in the lower lateral cervical region which requires the application of multiple hemostats and sutures uncomfortably close to the ureters is completely avoided.

2. Detachment of the divided and ligated uterine vessels from the lateral margins of the cervix down to the basal portions of the broad ligaments in addition to detachment of the bladder and pubo-cervical fascia anteriorly in order to drop the ureters considerably farther away where they are practically safe from mechanical injury.

3. The possibility of a postoperative streptococcus peritonitis from the cervix is reduced to a



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minimum not only through preliminary surgical toilet of the vagina and cervix but also by reason of the fact that at no stage of the operation is the cervix squeezed by the application of forceps to it. It is drawn into the pelvic cavity by a finger or hook introduced into the vagina adjacent to the cervix to serve as a guide in detaching it. Only the knife enters the vagina in this procedure as soon as the vaginal detachment is completed.

4 By means of a specially devised angle suture the severed ligaments of the broad ligaments and the uterine ligaments are firmly anchored to the lateral angle of the vaginal vault in such a way as to guarantee its adequate support. The uterine ligament attachment to the vaginal vault is also utilized.

5 The complete absence of hemorrhage which is accomplished with the application of multiple clamp and suture greatly simplifies the technique and permit perfect exposure of the field at every step so that an accurate anatomical dissection is carried out with ease and rapidity and without fear of damage to the ureter. The time required for completion of the operation is therefore ultimately reduced and the danger of surgical shock is eliminated.

Technique of the Operation 1 The bladder and rectum should be empty. Preliminary thorough surgical toilet of the vulva, vagina and cervix is first carried out. In addition the entire vaginal portion of the cervix and particularly the external os and cervical canal are thoroughly treated with the official tincture of iodine or 1 per cent mercurochrome or Scott's solution. The external os is then tightly closed by aseptic suture and a dry sterile gauze pack is introduced into the vagina one end of which is left outside to which a clamp is attached so that it can be readily withdrawn just before the vagina is opened above. The usual surgical toilet of the abdominal wall is then made and the sterile draperies are properly arranged.

2 A lower midline incision is made from the symphysis pubis to the umbilicus.

3 Adequate exposure of the pelvis is secured through use of the Trendelenburg posture to either with the judicious use of wet gauze packs.

4 The body of the uterus is now grasped firmly with an appropriate instrument and lifted well up provided only that its pathology is known to be benign in character.

If however malignancy has been demonstrated or is suspected the operation must be modified to include removal of both tubes and ovaries and it is particularly stressed that no compression whatever should be applied to the uterus either by instruments or by the surgeon's hand until its extrinsic blood and lymphatic channels have been absolutely blocked by ligation and division of its four cardinal circulatory trunk stems namely the two ovarian and the two uterine. This I believe to be a sound and effective precaution against the possible dissemination of malignant cells by squeezing them out into adjacent vascular currents.

5 A transverse crescent shaped incision is made through the vesico uterine peritoneum at the upper margin of its loose attachment to the uterus and is carried laterally on each side to the uterine attachment of the round ligament.

6 Into the angle of this incision on each side the index finger is introduced and curved bluntly through the loose areolar tissue of the upper portion of the broad ligament perforating its posterior layer close to the uterus and below the site of attachment of the round ligament the fall pian tube and the utero-ovarian ligament. The aperture is then enlarged sufficiently to permit the approximation of the structures to form a single pedicle to which two stout clamps are applied and amputation is completed between them close to the uterus.

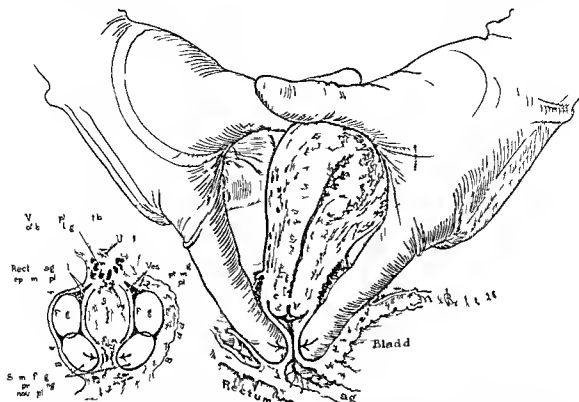


Fig 7 A sagittal view showing the test being applied to determine that the anterior and posterior dissections have been carried down to the proper level. The inset depicts the method of segmenting the vascular plexus on each side into a narrow zone adjacent to the basal segment of the broad ligament.

8. Transfixing ligatures replace the two clamps on the severed appendage stump while the two applied to the cornua of the uterus are henceforth used as tractors. The original instrument with which the body of the uterus was grasped for the purpose of elevating it is now removed.

9. Traction upward upon the uterus now brings clearly into view the skeletonized uterine vessels which are clamped and divided on each side at the level of the internal os. Ligatures replace the clamps on these vessels care being exercised not to include any cervical tissue in passing the needle.

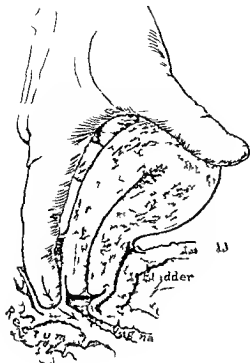
10. The severed uterine vessels with ease and safety may now be bluntly dissected away from the cervix down to the point of their emergence above the thick basal segment of the broad ligament on each side.

11. The uterus is drawn strongly upward and the bladder is easily separated by blunt dissection with the gauze covered index finger first from the cervix and then from the anterior vaginal wall well down below the level of the external os. In most instances the line of cleavage along the course of least resistance here is between the bladder and the pubocervical (subvesical) layer of fascia so that after the bladder has been pushed

well down close inspection of the cervix anteriorly will disclose that it is covered with a thin but definite layer of fascia. It is in this fascia that the troublesome vascular plexus is contained. If now a T shaped incision be made through the fascia with the transverse cut a little below the level of the internal os and the vertical one over the middle of the cervix the fascia layer together with the vessels may be easily freed from the cervix with the index finger and pushed laterally on each side so that the vessels are nicely segregated adjacent to the basal segments of the broad ligaments.

Steps 10 and 11 serve further to drop the ureters well away from the cervix where damage to them is scarcely possible if reasonable care is exercised in the subsequent application of clamps and sutures.

12. Strong traction upward and forward is exerted upon the uterus and a transverse incision is made through its posterior peritoneal reflection 1 centimeter above the level of attachment of the two uterosacral ligaments. The lower peritoneal flap resulting is quite firmly attached to the posterior wall of the cervix and sharp dissection vertically downward for at least 2 centimeters is necessary in order to free it sufficiently to permit introduction of the left index finger. Below this



The technique of the Operation 1. The abdominal cavity should be empty. Preliminary thorough surgical toilet of the vulva, vagina and cervix is first carried out. In addition the entire vaginal portion of the cervix and particularly the external os and cervical canal are thoroughly treated with the official tincture of iodine or 10 per cent mercurochrome or Scott's solution. The external os is then tightly closed by a *epicure* and a dry sterile gauze pack is introduced into the vagina one end of which is left outside to which a clamp is attached so that it can be readily withdrawn just before the vagina is opened above. The usual surgical toilet of the abdominal wall is then made and the sterile draperies are properly arranged.

A lower midline incision is made from the symphysis pubis to the umbilicus.

Adequate exposure of the pelvis is secured through use of the Trendelenburg position to ether with the judicious use of wet gauze packs.

4. The body of the uterus is now grasped firmly with an appropriate instrument and lifted well up provided only that its pathology is known to be benign in character.

If however malignancy has been demonstrated or is suspected the operation must be modified to include removal of both tubes and ovaries and it is particularly stressed that no compression whatever should be applied to the uterus either by instruments or by the surgeon's hands until its extrinsic blood and lymphatic channels have been absolutely blocked by ligation and division of its four cardinal circulatory trunk system namely the two ovarian and the two uterine. This I believe to be a sound and effective precaution against the possible dissemination of malignant cells by queuing them out into adjacent vascular currents.

5. A transverse resect shaped incision is made through the vesicouterine peritoneum at the upper margin of its loose attachment to the uterus and is carried laterally on each side to the uterine attachment of the round ligaments.

6. Into the angle of this incision on each side the index finger is introduced and turned bluntly through the loose areolar tissue of the upper portion of the broad ligament perforating its posterior layer close to the uterus and behind the clasp of attachment of the round ligament the fallopian tube and the utero-ovarian ligament.

The aperture is bluntly enlarged sufficient to permit the approximation of these three structures to form a single pedicle to which two stay clamps are applied and amputation is done between them close to the uterus.

minimum not only through preliminary surgical toilet of the vagina and cervix but also by reason

of the fact that at no stage of the operation is the cervix squeezed by the application of forceps to it nor is it at any time drawn into the pelvic cavity nor is either a finger or hook introduced into the vagina adjacent to the cervix to serve as a guide in latching it. Only the knife enters the vagina and this is discarded as soon as the vaginal detachment is completed.

4. By means of a specially devised angle suture the cervical basal segments of the broad ligament and the uterine peritoneal elements are firmly anchored to the lateral angle of the vaginal vault in such a way as to guarantee its adequate support. The usual round ligament attachment to the vaginal vault is of course also utilized.

5. The completeness of hemorrhage which is accomplished without the application of multiple clamp and suture greatly simplifies the technique and permits perfect exposure of the field at every step so that an accurate anatomical dissection is carried out with ease and rapidity and without fear of damage to the uterus. The time required for completion of the operation is therefore naturally reduced and the danger of surgical shock is eliminated.

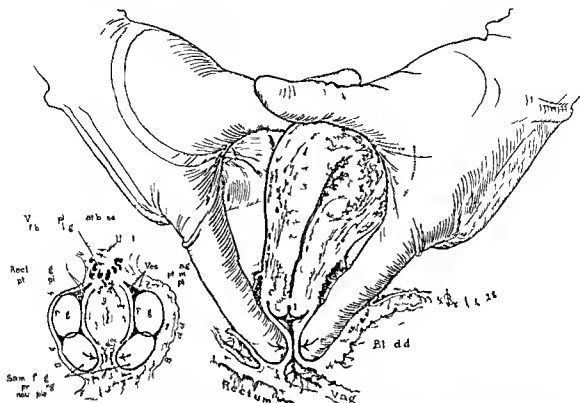


Fig 7 A sagittal view showing the test being applied to determine that the anterior and posterior dissections have been carried down to the proper level The inset depicts the method of separating the vascular plexus on each side into a narrow zone adjacent to the basal segment of the broad ligament

8 Transfixing ligatures replace the two clamps on the severed appendage stump while the two applied to the cornua of the uterus are henceforth used as tractors The original instrument with which the body of the uterus was grasped for the purpose of elevating it is now removed

9 Traction upward upon the uterus now brings clearly into view the skeletonized uterine vessels which are clamped and divided on each side at the level of the internal os Ligatures replace the clamps on these vessels care being exercised not to include any cervical tissue in passing the needle

10 The severed uterine vessels with ease and safety may now be bluntly dissected away from the cervix down to the point of their emergence above the thick basal segment of the broad ligament on each side

11 The uterus is drawn strongly upward and the bladder is easily separated by blunt dissection with the gauze covered index finger first from the cervix and then from the anterior vaginal wall well down below the level of the external os In most instances the line of cleavage along the course of least resistance here is between the bladder and the pubocervical (subvesical) layer of fascia so that after the bladder has been pushed

well down close inspection of the cervix anteriorly will disclose that it is covered with a thin but definite layer of fascia It is in this fascia that the troublesome vascular plexus is contained If now a T shaped incision be made through the fascia with the transverse cut a little below the level of the internal os and the vertical one over the middle of the cervix the fascia layer together with the vessels may be easily freed from the cervix with the index finger and pushed laterally on each side so that the vessels are nicely segregated adjacent to the basal segments of the broad ligaments

Steps 10 and 11 serve further to drop the ureters well away from the cervix where damage to them is scarcely possible if reasonable care is exercised in the subsequent application of clamps and sutures

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level the peritoneal and rectal attachment is quite loose and blunt dissection is now utilized first to free the peritoneum from the cervix and then is continued downward to release the rectum from the vagina below the level of the external os. Bleeding does not occur in this step of the operation if care is exercised not to carry the dissection laterally on either side into the broad ligament zone.

13 If the uterus now be lifted well up the two index fingers may readily be apposed below the level of the vaginal portion of the cervix by invagination of the anterior and posterior vaginal wall respectively thus demonstrating that the bladder and rectum have been freed from the vagina sufficiently low down.

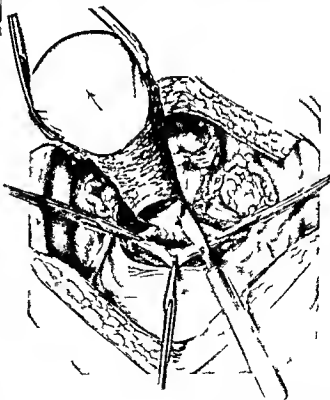
14 The two uterosacral ligaments are now clamped divided and ligated close to their cervical attachments.

15 The dense lacerated segment of the broad ligament on each side together with the vascular plexus adjacent to it which has been segregated through the earlier blunt dissection carried out over the central zone of the cervix in front and behind may now be easily grasped close to the

lateral border of the cervix divided and securely ligated the clamps being removed. If the cervix is elongated this step has to be repeated at a lower level.

16 The vaginal vault now comes up into plain view on all sides and the sterile gauze vaginal pack is withdrawn from below. Note that even at this stage of the operation there are no clamps in the pelvis and that no troublesome hemorrhage has been encountered. The anterior vaginal wall is incised the vagina promptly balloons and the incision is extended around the cervix four clamps being applied to the vaginal vault as it proceeds one anteriorly in the midline one laterally to each angle and one posteriorly in the midline as the entire uterus is lifted out of the pelvis without the cervix at any time having come in contact with any intrapelvic tissue.

17 Special angle sutures now replace the two angle clamps as follows: the needle is first passed through the anterior vaginal wall into the lumen of the vagina 1 centimeter mesial to the angle clamp it now twice transfixes the stump of the



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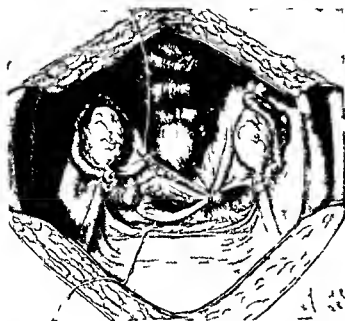


Fig. 10 The angle stitch is here shown. On the right it can be seen in detail. Note that it is first passed through the anterior vaginal wall 1 centimeter from the angle; it then twice transfixes the basal segment of the broad ligament plane, within this important structure a liberal mattress loop is then continues through the posterior vaginal wall 1 centimeter from the angle and is finally made to transfix the stump of the uterosacral ligament. On the left the suture has been tied snugly closing the vaginal angle and approximating to it the two important supporting ligaments.

basal portion of the broad ligament forming within it a liberal mattress suture loop from here the needle again enters the lumen of the vagina piercing its posterior wall also 1 centimeter mesial to the angle clamp and further is made to transfix the stump of the uterosacral ligament. When tied this suture closes the lateral vaginal angle and snugly apposes to it for support both the strong basal segment of the broad ligament and the uterosacral ligament.

18 Further complete or partial apposition of the anterior to the posterior vaginal wall by suture depending on whether or not drainage is to be employed is now quickly executed.

19 A single mattress suture on each side now first engages the closed vaginal vault anteriorly and mesially to the angle suture transfixes the stumps of the round and utero ovarian ligaments and passes back to engage the posterior vaginal wall opposite the point of entrance. When tied this suture snugly apposes the round and utero ovarian ligaments to the vaginal vault thus affording additional support to the latter and neatly suspending the ovaries.

20 The cut margin of the vesico uterine peritoneum is now neatly sewed to the free edge of the

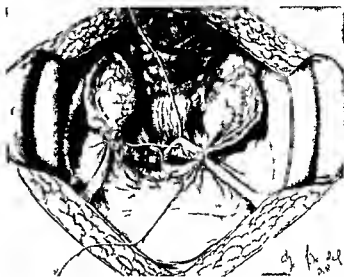


Fig. 11 The method of further closing in the vaginal vault and of suturing it both to the round and utero ovarian ligaments is here shown.

posterior peritoneal flap so that the pelvis is completely peritonealized with the vaginal vault and the ovaries strongly supported.

Modification A If for any reason unilateral or bilateral salpingo oophorectomy is indicated the technique described becomes even simpler and is readily modified according to well established procedure to meet this requirement.

Modification B If exposure of the cervix for the lower dissection is rendered difficult by reason of a benign pathological condition in the corpus uteri such as enlargement from a myomatous change it is recommended that a subtotal hysterectomy at or above the level of the internal os first be done. The cervix may then be easily and speedily removed by means of the technique as described.

SUMMARY

The perfected technique of this operation has been gradually developed during the past 4 years in which period I have used it a number of times for various types of uterine disease. Thus far I have had no mortality and no postoperative complications other than the minor ones uniformly associated with any major abdominal procedure. The operation is therefore now offered not with the optimistic fancy that no untoward results will later be chargeable to it but with the confident belief that it possesses the following distinct advantages.

1 Each step of the operation is anatomically and surgically sound in principle.

2 It is relatively simple, easy of execution and consumes substantially less time than has been hitherto required by most operators for abdominal panhysterectomy.

3 There is complete freedom from hemorrhage or troublesome oozing throughout which is accomplished by means of a carefully planned anatomical dissection that serves to coagulate the vascular network surrounding the lower cervix so that not more than four hemostatic clamps are required in the pelvis at any stage of the operation.

4 The danger of injury to the ureters is reduced to a negligible factor.

5 The accurate identification and preservation of the substantial basal portions of the broad ligaments and of the uterine sacral ligament for later coaptation to the vaginal vault by a specially devised suture afford an efficient guarantee against later prolapse.

6 The possible contamination of the field of operation or of the peritoneal cavity from the cervix harboring virulent organisms is reduced to a minimum.

The special step recommended in the case in which malignant disease is suspected (step 4) constitutes an additional protection against possible recurrence. This is a factor of unique functional merit.

8 Finally the factors which commonly produce shock and prompt exodus from the gynecologicotomy such as excessive loss of blood, extensive mechanical insult to the tissue and prolonged operative manipulation are completely eliminated through this simplified technique.

THE RÔLE OF POSTURE IN OBSTETRICS

JULIUS JARCHO M.D. F.A.C.S. NEW YORK

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NOTWITHSTANDING the present day excellent training of physicians in obstetrics both general practitioners and obstetricians are only too likely to overlook the usefulness of postural treatment for difficulties of labor. Whenever delay in the progress of the child is encountered or some complication intervenes one's first thought is apt to be of surgical interference. Yet in many cases simple postural treatment will terminate labor without the necessity of resorting to instruments.

King (8) in 1909 writing on posture in obstetrics said: "My chief contention is that the recumbent posture during labor is much overdone; that it is oftener persisted in either by custom or by the direct order of the obstetrician when it does positive harm by prolonging labor by exhausting the woman, sometimes leading to the persistence of faulty presentations as well as in increasing the duration and intensity of the woman's suffering."

King noted that in the recumbent posture the woman is deprived of one of the chief factors by which the child is expelled—that is the factor of thigh pressure on the walls of the abdomen and uterus which is effective in a sitting, kneeling or squatting posture. The squatting posture he maintains is a means of preventing transverse presentations or correcting them if they occur. In squatting one foot is usually placed in front of the other so that both thighs do not press equally on the surface of the abdomen and the direction of the pressure is not the same on both sides. When the squatting posture is used in a shoulder or arm presentation the foot on the side toward which the child's breech is directed should be placed forward. This thigh then will come in contact with the back of the child and lift it and the breech end up toward the median line. The other foot is posterior to this one and rests on the toes. The thigh comes in contact with the projecting head of the child and levers it off from the iliac fossa inward toward the median line and into the pelvic brim thus producing a head presentation. If the posture of unsymmetrical kneeling is adopted instead of squatting the woman puts one foot flat on the ground and kneels on the other knee (Fig. 1). In this case the foot flat on the ground must be on the side toward which

the breech of the child is directed. In either case the woman should remain in the posture long enough to have a few labor pains which aid in straightening the uterus and lifting the breech toward the median line. In neglected cases in which the woman has become too much exhausted to assume the squatting or kneeling posture we may obtain thigh pressure by grasping the legs and bringing thighs in contact with the abdomen.

King advocates the squatting or kneeling posture not only for breech presentations but also for prolonged labor in which forceps would otherwise be indicated as this posture hastens delivery. He advises that forceps never be applied in patients in whom the pelvis is normal until the effect of the squatting or kneeling posture has been tried. In cases of delayed rotation he suggests the trial of a kneeling posture with the woman kneeling on both knees and leaning backward on her folded limbs so that the pelvis comes in contact with her heels. In normal women the length of the leg is such that in this position the protuberance of the heel presses upon the great sacrospinous foramen so as to push the forehead of the child into the hollow of the sacrum on one side and cause the occiput at the opposite acetabulum to go to the symphysis pubis.

De Lee (1) writes that in cases of contracted pelvis the patient may be placed in the Walcher position at the end of the first and the beginning of the second stage. Since the softening of the pelvic joints in pregnancy permits the sacrum to become movable he states that we may rotate the innominate bones downward so as to enlarge the inlet by dropping the legs over the edge of the table on which the sacrum is fixed. Conversely this motion narrows the outlet by causing the lower ends of the innominate bones to approach each other by reason of the oblique direction of the articular processes of the sacrum.

Among the aborigines posture was an important means of treating difficulties of labor. The Indian women adopted a crouching position with one knee flexed completely and on the ground and the other one raised. The rationale of this position can be readily understood. If the fetal head is displaced into one of the iliac fossae it may be forced back over the inlet if the knee on the side of the displacement is raised.

chair without rungs between its back legs. The chair is placed on its face across the foot of the bed the back forming the inclined plane for the Trendelenburg position. The patient is prevented from slipping by means of a sheet passing over the shoulders and behind the neck. The ends of the sheet are tied to each rear leg of the chair. The buttocks project beyond the back of the seat. The legs are swung outward until the thighs hang outside the upturned chair legs. The weight of the lower limbs causes them to drop toward the floor the knee lying lower than the hip. With this position the vulva is at a convenient height for the operator and the direction of the canal formed by the vagina and cervix into the uterine cavity is more direct and more nearly level than in any other posture. Moreover the brim of the pelvis is enlarged to its greatest anteroposterior diameter by the Walcher position. This posture may be used for version, prolapse of the cord, high manual rotation of an occipitoposterior to an occipitoanterior position, flexion of a brow presentation, correction of a face presentation especially if the chin is to the rear, or in laparotomies when free access to the vagina is desirable as in cases of ruptured uterus or cesarean section. For ordinary delivery under anesthesia after the head has passed the brim the dorsal posture with the thighs strongly flexed against the abdomen is considered by Dickinson to be the best position as it measurably straightens the birth canal. This is also an excellent position for operations on the perineum and cervix.

Samuel (15, 16) has found that in normal labor as well as for various abnormal presentations other than transverse and when the pelvic outlet is slightly narrow the following procedure during the second stage of labor is useful. The patient is instructed first to flex the legs, then to rotate them outward and finally grasping the underside of the knee joint to flex the thighs strongly against the abdomen. In this way the pelvic outlet is widened and the pain of labor reduced, also the woman can use her own muscles to better advantage. When the head is sufficiently advanced so that a comfortable segment of it is visible and it is evident it must soon pass the perineum the patient may be turned on her left side but she should still keep her right leg flexed while the head is delivered so as to protect the perineum. For transverse presentations Samuel prefers the squatting position described by King. The Walcher position he says sometimes makes normal delivery possible with moderate narrowing of the pelvis or makes it possible to substitute a simple for a more complicated operation.

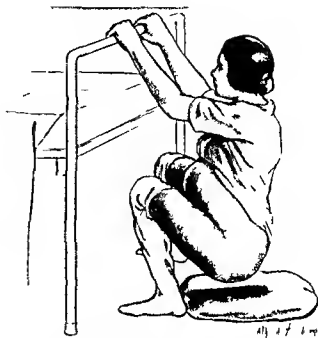


Fig. Squatting position. The thighs are flexed to an angle of 90 degrees, the abdomen resting on the thighs. The patient supports herself by hanging at the foot of the bed. The same position may be maintained by squatting on a cushion with the back against the wall and grasping the knees.

In the occipitoposterior position when the head is at the brim the placing of the patient on the side toward which the fetal back points helps the child's legs to fall forward, assists flexion, favors rotation of the back forward and may secure engagement in the anterior position.

An objection frequently raised against the use of the Walcher position is that it causes discomfort. Since the position must be maintained for some time to be effective it is essential to make the patient as comfortable as possible during its use. For example if the feet are supported the Walcher position may be maintained for 45 minutes whereas without this support it can be held for only 5 minutes or 10 minutes at the most. To allow the comfortable and sustained use of the Walcher position I have designed an obstetric table equipped with a shelf on a sliding rack that can be adjusted exactly to fit the height of the patient. For home deliveries one can improve a comfortable way of maintaining the Walcher position by having the patient place her feet on a foot stool or cushion.

Simms (17) states that the obstetric chair was in use for many centuries but in recent times seems to have fallen into complete disuse. He quotes a description of the obstetric chair from the first book of Soranus of Ephesus on the diseases of women as follows:



The position is used to advance the fetus in the pelvis and to relieve the pressure on the uterus. It has been used in China since ancient times. Hartmann (1) notes that it is now used for labor and maintenance of the fetus after delivery with the aid of a pillow or a small stool. The maintenance of the position is particularly useful in Chinese cases of placental separation of the fetus in the uterus.

In cases of placental abruption in the abdominal region, the patient is placed in the position of the squatting posture. It relieves the uterus and the fetus in the same direction as that of the pelvis. With this position the force of the uterus is increased and the fetus is directed backward toward the pelvis instead of ahead of the pelvis.

The following illustrations show the value of the position in cases of placental abruption. The first illustration shows the patient in the position of the squatting posture. The second illustration shows the patient in the position of the squatting posture. The third illustration shows the patient in the position of the squatting posture. The fourth illustration shows the patient in the position of the squatting posture. The fifth illustration shows the patient in the position of the squatting posture. The sixth illustration shows the patient in the position of the squatting posture. The seventh illustration shows the patient in the position of the squatting posture. The eighth illustration shows the patient in the position of the squatting posture. The ninth illustration shows the patient in the position of the squatting posture. The tenth illustration shows the patient in the position of the squatting posture.

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Lichtenstein (9) advises that after the child is delivered the patient be placed in a squatting position with the knees and hips flexed. She should grasp the thighs near the knee joint to hold this position comfortably. The position should be maintained until the placenta is completely separated and again for about three-quarters of an hour after the delivery of the placenta. The woman is not moved from the bed but the head of the bed or mattress is raised and two or three cushions are laid against it on which the patient squats. Lichtenstein maintains that this position insures complete separation of the placenta with the minimum of bleeding and prevents atony of the uterus. In 60 of 100 cases the squatting position was used and it was found that it did not diminish bleeding. It has no other advantage over the usual method of obtaining separation and delivery of the placenta. Steinmetz (18) observed among the Indian tribes that Tonkawa women maintain the squatting posture until after expulsion of the child.

In women with a lightly contracted anteroposterior diameter of the inlet or with a normal inlet but slightly overgrown child the anteroposterior diameter of the inlet can be increased from 0.5 to 1.0 centimeters by the use of the Walcher position (Fig. 5). This position frequently enables one to obtain a normal delivery in cases in which the use of instruments is otherwise necessary. Even if it does not avoid the necessity of instrumental delivery it may make a simpler form of interference possible. For example, a pair of forceps in the case of a high forceps operation. Even in mediocrity it is used when fat women were to be delivered (11, 4).

In 1895 Dickinson (11) has used the use of a combination of two operations, positions in obstetrics in the presence of certain complications, namely the Walcher and the Trendelenburg deliveries in hospital where an operation table is available the patient is placed in the Trendelenburg position and the child is delivered. In the sacrum the lower half of the body is in a house the posture is easily improved by a woman in a

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chair without rungs between its back legs. The chair is placed on its face across the foot of the bed, the back forming the inclined plane for the Trendelenburg position. The patient is prevented from slipping by means of a sheet passing over the shoulders and behind the neck. The ends of the sheet are tied to each rear leg of the chair. The buttocks project beyond the back of the seat. The legs are swung outward until the thighs hang outside the upturned chair legs. The weight of the lower limbs causes them to drop toward the floor, the knee lying lower than the hip. With this position the vulva is at a convenient height for the operator and the direction of the canal formed by the vagina and cervix into the uterine cavity is more direct and more nearly level than in any other posture. Moreover the brim of the pelvis is enlarged to its greatest anteroposterior diameter by the Walcher position. This posture may be used for version, prolapse of the cord, high manual rotation of an occipitoposterior to an occipito anterior position, flexion of a brow presentation, correction of a face presentation especially if the chin is to the rear, or in laparotomies when free access to the vagina is desirable as in cases of ruptured uterus or cesarean section. For ordinary delivery under anesthesia after the head has passed the brim, the dorsal posture with the thighs strongly flexed against the abdomen is considered by Dickinson to be the best position as it measurably straightens the birth canal. This is also an excellent position for operations on the perineum and cervix.

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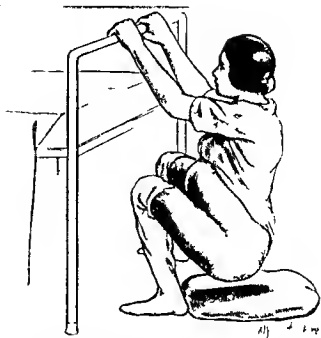


FIG. 2. Squatting position. The thighs are flexed to an exaggerated degree, the abdomen resting on the thighs. The patient supports herself by hanging at the foot of the bed. The same position may be maintained by squatting on a cushion with the back against the wall and grasping the knees.

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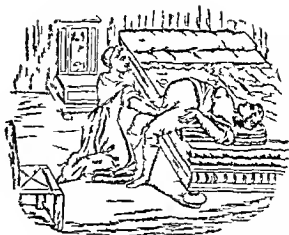


Fig 4 Th m l t t f th W l l r p t u l
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The obstetric chair is required to put the patient in the proper posture for delivery. In construction it is a chair having in the center of the seat where the birth takes place a moderately large piece cut out round in shape. This space must be wide so as to allow the hip of the patient to slip through, nor again too narrow to cramp the perineal region, which in the case of the patient would be painful. Underneath the seat the chair should be boarded in on the right and left sides but the front and rear should be left open for the purpose of the delivery. There should also be affixed to the seat on the right and left sides two arm rests for the patient to grasp during the pains and in the rear a leaning support to prevent the loins and hip slipping back.

Simms states that during the earlier times of this rite the patient lay on the couch in the fetal position until examination showed the fetus to be sufficiently dilated when she was transferred to the obstetric chair. If she was in a crouching position the obstetric chair was at hand and labor would proceed to termination in the such with the modification however that the final stage were completed in a sitting posture.

Engelmann (4) writes that the semi-recumbent position is far the most frequent among the ancient, especially among the more civilized people of all time and among the savages of the present day. The simplest of the semi-recumbent positions which is upon a pair with the cushion of the rude African races

continued Engelmann is sitting upon the ground upon a tone or rude cushion with the body inclined backward leaning against an upright post or some other object. A marked progress is achieved when we find the parturient woman seated in the lap of another reclining against his chest a position which reaches its greatest perfection in the obstetric chair.

Simms states that the most interesting phenomenon in the history of childbirth is the discontinuance of what is probably the natural mode of delivery—a mode that the ancients have left to assist by the use of the obstetric chair. The nations of the Orient still use the obstetric chair.

Of late years I have been placing almost all of my obstetric patients in the obstetric chair prior to delivery until labor is well advanced. In general the patient gives no great trouble in walking, is encouraged and in interval is urged to rest in the obstetric chair in order to avoid recurrence.

Markoe (11) states that the obstetric chair was used in Europe through the Middle Ages and up to the end of the eighteenth century, then it gradually fell into disuse although it was still employed in some rural communities in various countries.

Largely as a result of Markoe's work the use of the obstetric chair was again brought to the attention of the medical profession. In 1914 Markoe reported that he had devised an obstetric chair that had been used in a few cases in the Lying-In Hospital of the City of New York. In 1915 he reported 15 cases in which the obstetric

chair was used and in 1917 320 cases (including the first series of 179 cases). Summarizing the results in the latter series he stated that in about 60 per cent of the cases labor lasted only an hour or less after the patient was put in the chair in one case in which the cervix was almost fully dilated at the time 15 minutes was sufficient for delivery. In 18 cases in which the cervix was only one or a few fingers dilated less than one hour was required. In 21 primiparæ where anatomical conditions might have rendered operative interference necessary spontaneous delivery occurred. In other words in about 37 per cent of 56 cases the obstetric chair apparently obviated the necessity of any other artificial aid. Of 23 multiparæ with right occiputoposterior positions 11 or nearly 50 per cent were delivered spontaneously by the use of the obstetric chair. In 1 of 4 left occiputoposterior positions in 3 cases of transverse position and in 1 case of chin posterior position delivery was also spontaneous. Of 9 multiparæ with normal pelvis all but 1 were delivered spontaneously and all but 1 of them in less than 2 hours.

In the home a rocking chair padded with pillows and blankets can be made into an excellent obstetric chair. In the first stage of labor when regular contractions have begun the patient may sit with her knees elevated to support the abdomen. For patients with pendulous abdomens the chair can be tipped backward so that the axis of the uterus points directly into the pelvis as with the hospital chair (Fig. 6).

The advantage of the use of the obstetric chair Markoe claims is the placing of the woman in the upright posture tends to give the natural expulsive forces every chance with the addition of the direct action of the weight of the child plus the fluid contents of the uterus always in a downward direction toward the point of least resistance that is the softened cervix which nature has already prepared for dilatation. In cases in which the membranes are already ruptured the presenting parts act in the same way though naturally somewhat slower.

When the rocking chair is used in labor the patient should recline backward and rest her feet on a stool or chair. In this way flexion of the thighs can be regulated according to indications. She should be made as comfortable as possible by properly arranged blankets and pillows and instructed to make use of the pains by holding her breath and bearing down. Another feature of the rocking chair is that the patient can place her arms on the side rests and pull upon them during the pains and also relax and slumber between

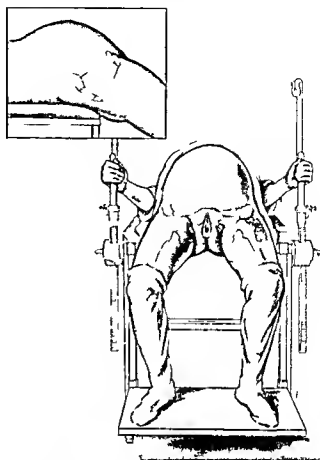
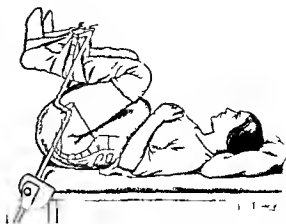
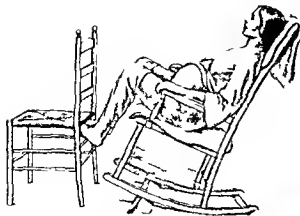


Fig. 5 The author's table. The feet rest on a sliding shelf enabling the patient to maintain the Walcher position in comfort long enough to be effectual. The insert shows how the anteroposterior diameter of the inlet is increased by the use of the Walcher position.

them. Moreover in the upright position the expulsive forces are used to greatest advantage to help overcome any tendency to malposition.

This posture in the rocking chair is also helpful in cases of pendulous abdomen when the patient tires of the squatting position. In such cases however a higher chair should be placed under the feet so as to flex the thighs more sharply against the abdomen and push the uterus into a better position (Fig. 6).

In 1905 Gellhorn (5) described a new delivery bed with footrests encasing the entire foot on a height with the table i. e. on the same level as the patient's back. With this bed the legs are not elevated as they are when held by attendants or by mechanical leg holders. Thus the perineum is not overstretched, the pelvic outlet is not tilted upward and the patient is able to utilize the abdominal muscles to the best advantage. When she reaches the second stage of labor she is moved toward the lower end of the bed until the buttocks are even with or one half inch beyond



I 6 U of the k g h n Wh th k e
 fl d th of the tru pit d th t le pel
 l the p i f e a u l e g t e t a l tag
 Wl th b d m p dul the f t m y be pla d
 l h a d th abd m m th to th th gh

I Th th ttle th rut h hilt db lt
 pla ti jat t e g t d l th t my p t
 Th l t t th p l d e th d m t f
 the t t t

the edge. The feet are placed at a comfortable distance in the footrests and the knee rests adjusted until the knees rest securely in them. With the patient in this position the perineum is more relaxed than with other forms of leg holders. The entire progress of labor can be easily observed and the position of the patient is comfortable and can be maintained for hours.

In cases of contraction at the outlet the exaggerated lithotomy position raises the pubis and increases the diameter of the outlet. In my obstetric table I have so arranged the crutches that they may be shifted backward thus allowing the patient to assume the exaggerated lithotomy position. One must note however that although the outlet is increased by the exaggerated lithotomy position there is a greater tendency to perineal lacerations. Therefore unless episiotomy is contemplated it is best to diminish the flexion of the thighs and bring the patient to a more classic lithotomy position as soon as the head is on the perineum.

When one is performing version the patient may be placed in a modified Walcher position the latter position that is the thighs are not allowed to drop as low as in the true Walcher position. To obtain this position on my table the crutches are allowed to drop below the level of the top of the table. This position may be held with comfort. In the home the legs may be allowed to rest on chairs. An exaggerated lateral prone position with elevated pelvis will often help to replace a prolapsed cord or small parts of the fetus.

The value of posture in the treatment of pro-

lapse of the cord is illustrated by the following case:

M P I d s p m p dm tted to th
 S d h m Ho p t l v l ch s 9 q with b h p e
 t t Th m mb l d upt d he th a
 ly n d a h l f g d l t e d a d th d p
 l p d The p t nt a f t p l d th k h t
 p t a d th th g t p t of th d p p d k
 t t ut ru a d l d b felt th t n l by e l
 m t Sh w the pl d the e a f
 l t l p o p t Th th h w fle d th
 b d m n th S m m p t lutt ag at d
 d th h p el t d by t p l l c d n d
 th p l Th p t k p t h l q m f o m d a
 g f n d p m t d th o d t g a t t t the t r u
 A th l t b ch d l f m th let t n
 t e t t d m h d f d f q n v
 A i n a l p h l p f med Th it
 ag d t l f th pat t d l c e d t l l y d a l
 h l d b t a d

In cases of prolapse of the fetal parts the Trendelenburg position may be assumed instead of the knee chest. It has the advantage that it may be maintained longer and that the patient may be anesthetized in this position. With reference to the Trendelenburg position it must not be forgotten that this is the most favorable one for the treatment of postpartum hemorrhage and shock. After the bleeding has stopped the patient should be removed from the table and placed in bed with the foot of the bed still elevated. According to Edgar (3) the Trendelenburg position is used extensively in laparotomies in accidental to obstetric practice for example in extra uterine pregnancy. Moreover it may be employed as a substitute for the knee chest

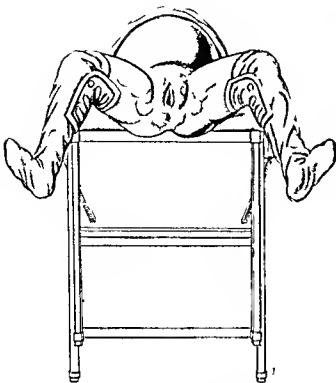


Fig. 8 The author's table. The crutches are allowed to drop below the level of the top of the table. Modified Walcher or Potter position for delivery.

position over which it has advantages in that it is more natural and modest, can be endured indefinitely and does not conflict with the administration of anesthesia. The Trendelenburg position, writes Edgar, may be improvised by various means; an incline may be formed from an inverted chair and several pillows, or the woman may rest head down upon the back of a strong attendant with her knee hollows upon his shoulders and her legs held in his hands.

The knee chest position is useful for replacing the retroflexed gravid uterus during the early months of pregnancy, also for the prevention and correction of postpartum retroflexion. I advise every patient 3 weeks postpartum to assume this position for from 5 to 15 minutes twice daily. The monkey trot recommended by Polak (14) is also a great help in correcting this displacement.

The use of Fowler's position postpartum helps drainage of the uterus and is especially to be recommended for patients who show signs of pelvic inflammation, since it favors the localization of the inflammatory process low in the pelvis.

SUMMARY AND CONCLUSIONS

1. Appropriate postures used during difficult labor frequently obviate the need of instrumental delivery or enable one to substitute a simpler for a more difficult operative procedure.



Fig. 9 An exaggerated lateral prone position with elevated pelvis.

2. The squatting position during delivery, which was much used by aboriginal women and is still employed by the Chinese, has unfortunately fallen into disuse. Yet it is undoubtedly of great aid in labor, particularly in cases of pendulous abdomen, as a preventive of transverse presentation and as an aid to weak labor pains.

3. The Walcher position increases the anteroposterior diameter of the inlet from 0.5 to 1.0 centimeters. When the pelvis is slightly contracted or the fetal head is a little oversized in a normal pelvis, the use of this position often facilitates engagement.

4. The use of the obstetric chair is a help to delivery. In the home, an obstetric chair may be improvised from a rocking chair padded with blankets and pillows and a couple of stools as footrests.

5. The treatment of obstetric difficulties with postures should appeal particularly to the physician in rural districts where hospitals are inaccessible. It is eminently practical as a substitute for interference, especially when the environment is unfavorable to surgical procedures.

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11 m D H c k t V b u r g n N I 5 S M E L M U b L e h t r u n d e r A u t t
 b t b l t g I o t h d T h e p 9 7 l e g u n g d a h e l d e l l t g d G
 M L J W V l f t h l t e t h B l l 6 I d m U e b L r l c h t r u g d C l t M h
 I b d g l H p V k q t 4 296 m e d W h c h 19 l 388
 3 11 m l t n b i t I b d 9 S u r S O b t t h a c e t m e c h t
 4 l J O A n J O f t & G y n 9 43 a p p l a B t M J 9 4 29
 8 S t I N M E T Z C t e d b y E n g l m p 5

MESENTERIC DEFECTS

WITH SPECIAL REFERENCE TO THEIR ETIOLOGY AND REPORT OF A CASE OF COLONIC OBSTRUCTION

JAMES R JUDD M.D. F.A.C.S. H. L. U. H. I.

INTESTINAL obstruction caused by a loop of bowel passing through a slit opening rent aperture hole or hiatus in the mesentery as it is variously called is a rare condition. Little or nothing is written in the textbooks about this condition but there has been considerable written in the form of case reports. Sir Frederick Treves in his *Applied Anatomy* writes as follows:

C t h l m t m l d m t h m e t v
 t l g l w h h t h t t i n e h a b t g u l t e d S m e
 f t h e h l p a l l y t l t t f t l i k e a d m e
 t j y t h e d t g s t l d e f e c t f t h
 m e t e v

Keen, Davis, Kemp, Boas and other authors briefly mention the subject. Brown in 1920 reported a case and found only 19 cases reported in the previous 25 years and Cutler in 1935 reported 8 additional cases including one of his own making 8 in all. In the literature since 1935 no further reports of this condition have been found.

It is noteworthy that in all but one of the 8 cases reported it was the small intestine that had become strangulated. Hamaker in 1914 reported the only case of strangulation of the colon.

T l t t w f m l g d y a w t h h t y
 f b t t t t p t f m v a T h e
 u d d t f y m p t m f b t r u t O p a t a
 d t h t h d d y f t t f t y m p t m d
 a l d o p g d t e o f a g g t h m d t y
 t h g h w h h d p e d t h e l o n d m
 t m T h d t w a f d y o f l g t a d g
 h v i l l d p t

Hohlbaum in a study of 3 cases of ileus caused by the small intestine entering a defect in the mesentery drew the following conclusions. The usual location of the defect was in the lowest portion of the mesentery near the ileocaecal junction. The mesentery in that region is often

found to be thin and lacking in fat and blood vessels. Trauma as a cause is rare and the presence of other anomalies indicates a congenital condition.

In the case reported by Brown the cause was evidently traumatic as the condition developed 2 days after a fall and it was noted at the operation that the opening in the mesentery had rough edges apparently of recent origin.

Prutz's theory that the cause is inflammatory is not substantiated by operative and postmortem findings.

In Cutler's summary of the 8 cases reported the ages of the patients varied from 1 to 73 years. More than half the patients were under 50 years of age. A history of trauma is mentioned in 1 instance only and previous attacks of abdominal pain in 6 cases. In none of the cases reported was a correct preoperative diagnosis made. The mortality was over 50 per cent.

The following report is made of a case in which the colon had become strangulated through a defect in the mesentery.

A S p l b e d y w a l m u t t d t h
 O n H p c l H l l I b r u r y 4 9 8 T h
 o h t o f f p o t t k l b d m u n l p o f
 t m a T h d y b f d m t h p t n t
 d d l y d w t h b d m l p d m t g s r a l
 d f t r l h d b j e t e d d r a l m
 h d b g w t h t l t l m t g a d p h
 t a u d t h b d m h d b e m t d t d d
 E a m u t s h w e d b y d p e t d t
 p l 3 t m p t b m l l o s e
 p h d b d l d h y d r t e d b d o m m l y d i
 t d d d e d t m p t t p m
 w m d o t R t a l m t t m
 t t a t d w a f n t e s t l b t r u t d t t
 p t m d l t h g l t g n j t h t t h e
 h t n t b l d m d l l g b t
 O p e t w a p f m d e l h t t h a t h
 H y p o d m c l y f l m l t a t e d t
 a l s o t e j e c t f g l s o l t T h

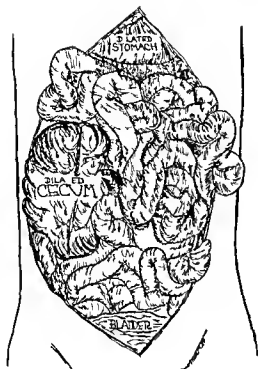


Fig 1 Condition found at laparotomy. The astrointestinal tract is greatly distended to the site of the obstruction of the transverse colon

stomach was emptied of a large amount of fecal smelling material by nasal catheter lavage. A right rectus incision was made. There was a moderate amount of bloody fluid in the peritoneal cavity. The entire intestinal tract to the site of an obstruction of the transverse colon was greatly distended. The colon carrying with it the lower ileum was found to pass through an opening near the center of the mesentery of the small intestines. The opening was circular about 1 inch in diameter and the margins were smooth and firm. The proximal colon was distended to the size of the child's mid thigh. The colon beyond the constriction was flat and empty. There was a short fringe of great omentum hanging down free from the greater curvature of the stomach also there was a rudimentary fringe of omentum coming off from the left portion of the transverse colon. The gas was evacuated by puncture of the cecum the colon was freed from the margins of the aperture and the opening dilated sufficiently with the fingers to allow the colon and lower ileum to be manipulated back through the opening. The aperture was closed by a few sutures and the colon was brought forward to a normal position below the stomach. The appendix was removed as a precautionary measure. The congested purple bowel responded satisfactorily to the influence of moist heat so the abdomen was closed without drainage.

The patient had a temporary postoperative 3 days. Reliance was placed on salt solution and glucose given intravenously and by rectum also the use of a 1 per cent solution of ammonium chloride as recommended by Haldane. Lifts and other for the purpose of resting the blood clonides. The abdomen was exposed to the sun's rays every day commencing with a 1 minute exposure and increasing 5 minutes a day to 35 minutes. The valuable method of treatment possible in Hawaii even in February. The boy made an excellent recovery and walked out of the hospital on the twentieth day.

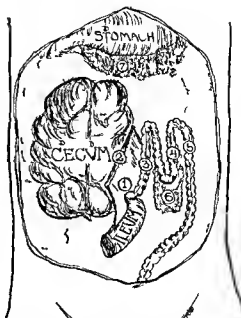


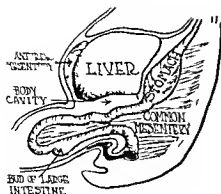
Fig 2 Conditions found at operation. The dotted line indicates the proper position of the colon. 1 Position of mesenteric defect through which transverse colon and lower ileum had become strangulated. 2 Cut edge of mesentery. 3 4 5 empty colon. 6 rudimentary omentum. 7 fringe of omentum from lower border of stomach.

ETIOLOGY

The three causes given for this condition are inflammation, trauma, and congenital defects. Inflammation as a cause is discredited by the operative and postmortem findings. Trauma, because of the history and signs of recent injury found at operation, must be accepted as a cause in some instances.

Congenital defects of the mesentery are responsible for the majority of cases reported. It is an interesting question whether there is a pre-existing actual absence of tissue in the mesentery through which a loop of intestine finds its way by accident or whether there is some definite factor that forms these abnormal openings and accounts for the hernia of the intestine.

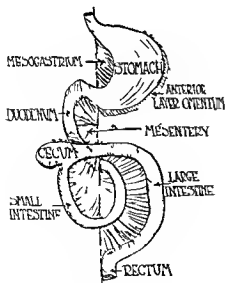
According to the researches of Mall at the seventh week of fetal life the rapidly increasing liver occupies so much space in the small abdominal cavity that there is insufficient room for the expansion of the intestinal tube. The greater part of the intestine in consequence is displaced from the abdominal cavity into the coelium within the umbilical cord. At 10 weeks on account of the increase in size of the abdominal cavity the intestine returns from the umbilical cord into the abdominal cavity and the coelium of the cord is obliterated soon afterward. Once back in the peritoneal cavity the loops which collectively lay in the sagittal plane of the cord are arranged



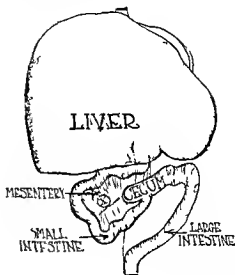
I 3 D g m l g d m h t f th i t l
t l t t l m l l d th k f f l l f
(M d t l f m l ol // t t v)

generally at right angles to the long axis of the body and the anteroposterior colon becomes transverse (Mall). The portion of the colon that lay within the cord now lies obliquely across the abdomen in front of the duodenum.

In attempting an explanation of this rare form of hernia it is reasonable to assume that the abnormal opening in the mesentery is caused by pressure rather than that the opening existed as an actual lack of tissue through which the intestine subsequently found its way. The fact that the greater part of the gut is displaced from the abdominal cavity into the umbilical cord indicates that the pressure to accomplish this purpose must be considerable. Figures 4 and 5 show the possibility



I 4 N I l c f lo c in d od m
d n f t l l f D tted l t l e the l e (M d h d
f m T u c u)



I 5 D m l t t th l b l y f the arc m
b p d th g l th m t j y p e of p d l y
g g l

that sufficient pressure exerted against the colon might influence its position so that instead of crossing the duodenum at this period it might lie to the left of the small intestinal loop. The pressure continuing as the intestine migrates into the cord might cause the colon to continue along the path of least resistance and gradually force its way through the delicate structure of the mesentery.

Fusion of the omental sac and the transverse colon and mesocolon takes place in the fourth month of the fetal life. As fusion had not occurred in this case reported it is evident that the misplacement of the colon must have occurred at an early period.

SUMMARY

1. Intestinal obstruction caused by the intestine passing through an abnormal opening in the mesentery is a rare condition only 9 cases having been reported.

Strangulation of the colon in this manner has been reported only in one instance (Hamaker). The report of this case makes the second case report of colon strangulation.

3. In Hamaker's case the condition was evidently acquired. In the present case report the condition was congenital. Apparently this is the first case report of strangulation of the colon through a congenital mesenteric defect.

4. The migration of the intestinal tube from the abdominal cavity into the umbilical cord at the seventh week is caused by pressure of the rapidly growing liver. In rare instances this

pressure may be so directed that the intestine is gradually forced through the delicate membrane of the mesentery.

5 The pressure theory makes the causation of the condition easier to understand than the idea that there is a pre-existing lack of substance in the mesentery through which the intestine finds its way later on.

6 Embryological defect may be considered to be the cause of the condition in the majority of cases occurring in the young. Rarely trauma may be responsible for the aperture in the mesentery as in Brown's case in which the opening showed ragged edges. Trauma may act by precipitating a strangulation in a pre-existing hernia through the mesenteric aperture.

7 There are no pathognomonic symptoms to distinguish this condition from other forms of

intestinal obstruction and a correct pre-operative diagnosis has never been made. Possibly X-ray examination may lead to correct diagnosis in the future.

8 Operation is imperative. Lavage, water, glucose and chlorides are indicated as in intestinal obstruction in general.

My thanks are due to Dr F. J. Halford for his assistance on the case and for the drawing.

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Fig 1

Fig 11

Fig 1 Left shoulder as it appeared October 20 1924

Fig 11 Left shoulder as it appeared June 11 1935

and distal end of the bone appear to be normal. Both humeri seem to be somewhat shortened but measurement shows them to be approximately 28 centimeters in length. The radius and ulna show remarkable and interesting changes that give the forearms a peculiar deformation. The right forearm has suffered less than the left and is a little longer. The upper halves of both bones of the forearm seem to be normal in almost every way. The right ulna from the tip of the olecranon to its opposite end measures on the X-ray plate exactly 18.5 centimeters; the radius from the flattened summit of its head to the tip of the styloid process 21 centimeters. At 14.5 centimeters below the tip of the olecranon the shaft of the ulna gives off several blunt broad spurs, one internally, one externally and perhaps near anteriorly each about a centimeter at the base. At this point the osseous tissue becomes porous and gradually tapers to a blunt point tipped with cartilage. The ulna at its inferior extremity lacks 2 centimeters of reaching the wrist joint and does not touch the radius. The left ulna except that it is more than ordinarily curved and has a small pointed spur arising 3 centimeters above the styloid process is normal.

The left ulna also measures 18.5 centimeters in length and is normal at its upper end remaining so until a point 7.5 centimeters above its tip is reached where it gives off an osteocartilaginous formation having a base of nearly 3 centimeters, a greatest projection of 1.2 centimeters and meeting by an irregularly flattened surface, a similar but smaller malformation springing from the radius as though to meet it. Below this growth the shaft of the bone continues normal for 3 centimeters when it abruptly terminates in a sharply margined regularly rounded extremity from the apical convexity of which a small steatocartilaginous mass of 0.7 centimeters in diameter and of rounded form springs. The left radius is quite normal from its head to a point 11 centimeters below where it suddenly broadens and gives off on the ulnar side a broad flattened exostosis (?) as though to articulate with that upon the ulna. It is difficult to escape the conclusion that in the pronation and supination of the hand these exostoses play upon one another in such a manner that each meets the other by a broad flat surface (pseudarthrosis). Except for the increased breadth already mentioned and a little pointed spur like that upon its fellow of the other arm, the distal end of the bone is normal.

The carpal bones all appear to be normal. The metacarpals of the third and fourth fingers of the right hand are shorter by 0.5 centimeter than the corresponding bones of the left hand. The phalanges all seem to be normal.



Fig 3 Shoulders as they appeared January 6 1928
The change in the shape of the internal tumor is very distinct. The anterior external tumor appears to be an entirely new growth.

The shortening of the ulna and their failure to play their customary small parts in the formation of the wrists determines that each hand turns toward the ulnar side to an extent that strikes the observer as unusual. The right hand turns a little more than the left and its position may have something to do with the shortening of the inner metacarpals. As the left ulna is more widely separated from the wrist it is probable that it would turn in more were it not for the support the ulna receives through its exostosis meeting the radial exostosis and keeping it rather widely separated and affording the wrist some breadth of support.

The *osssa innominata* only partly shown in the X-ray plates seem to be without interest.

The femora are generally well developed and apparently of about normal length. They show no distinct pathological lesions. The lower legs show abnormalities analogous to those seen in the left forearm.

The right tibia measures 35 centimeters in length. The head and upper two thirds of the shaft are generally well formed except that on the inner side below the internal tuberosity and at about the level of the tubercle there is a small projecting spur of bone. About the junction of the middle and lower thirds there is a point 5 centimeters in extent in which the X-ray picture is a little confused but at which a broad flat exostosis seems to arise to meet a similar exostosis projecting from the fibula forming a condition homologous with what was found in the left forearm. As the lesions superimpose it is difficult to make out the precise outlines of either or to say which was the larger or how their surfaces came into contact. Below this point the bone loses its outer compactness and the medullary cavity is distinct and for some 5 centimeters the bone becomes more and more cartilaginous until at the internal malleolus it consists almost entirely of cartilage.

The right fibula is much altered. Its head which is large and has a sharp spur externally is largely cartilaginous and gives off anteriorly an osteochondromatous mass that measures 5 centimeters in the length of its attachment and extends anteriorly 3 centimeters to the crest of the tibia. At a point 7 centimeters below its upper extremity the shaft of the bone becomes normal and remains so for 10 centimeters when it gives off from the inner aspect the exostosis to meet the similar lesion arising from the tibia. The lower end of the bone like that of the tibia is very porous—probably largely cartilaginous—and has several large rounded but somewhat flattened protuberances.

The left tibia has a head much diminished in density presumably because of an excess of cartilage. It is generally



Fig 4 L f t f m t p p t h t g m
m d j o m t h v p p d m
I s F m t h v p p d m
J v 6 o q Tl m t b d f t m
I v f t h l f t d

Fig 6 Upp d f h t b l a O t b 9 4
f L l J v 6 8 C m p 4
h w t h t m f t h t v p o 8 t t t m p l
d t h d m h d d t h t t b d f b l
l l t h p t h t h

will h p d d f m l l t h t m t) B t
t b t t h j t f t h p p t h f t h t h t
l o f t h t t f t h l l y t m t
m l p q t t t f m t h f b l j t
t h t h l t h h l t i v m l l d l
l l v l p p g f t h t p t b t
d g t h m p t t t h p j t f m t h t b
d d m m p l t l f d t h t t f m t h
t b l B l t h p t t h h f t h l l l
f m d d t h t l m l l m t b l g l y
t l
Th l f t f b l m h l k t h t h t h d d l k
l l l v t l g d h f g d r d f t h
t l p B t t h t t t f t h d d f t h
f i t l d t h t b i a t h d h t d t f g
l t t h t f f t h t b t h g h l l m y l l y
d p d p t h l k d m p f t h d f t h h l l
Th h f t l l f m d t t h p t w h h t e o
h d m g n f t m t t t g f m t h
t b a d t h d f m t h d t b t
f s d d l l y t l Th l t l m
f t l f t t c t h t p f t h t i m l l i Th t

fortunately very dark but they both show that at 12 centimeters from the upper end of the bone the point at which the upper and middle third join the shaft completely lose its compact tissue and rapidly increases in breadth in the direction of the head chiefly through the formation of a large blunt process that arises from a base approximately 6 centimeters in length projects fully 3 centimeters and has a broad rounded summit with a slight dent on the upper surface. The whole of this upper end and this process seem to consist of cartilage with scattered trabeculae of bone. On the external surface there is no process or exchondrosis but a small spur appears almost opposite to the lowest point of the increase in thickness. The clavate end of the humerus seems to lack the tuberosities and the anatomical neck is scarcely discernible. The large exchondrosis is broader and blunter in the older plate and in the 4 years intervening between the studies made at Union College and those here recorded there have been marked changes for the bone has become more shapely and the tuberosities and anatomical neck have differentiated though the tissue remains largely cartilaginous. The large blunt process has apparently elongated in its projection—it is now nearly 4 centimeters beyond the line of the shaft but has lost much of its original bluntly conical form and narrowed from above downward at its base until its shape is not unlike the end joint of the forefinger. It has also become trabeculated with bone. But while this lesion visible in the old plate has become

The patient was formerly a student at Union College Schenectady New York and while there X-ray plates were made of a few bones in October 1924. Fortunately some of them are still in existence and have been lent in order that his past and present conditions may be compared. These plates made when the patient was about 18 years of age leave much to be desired but show the upper end of the left humerus the lower part of the left radius and ulna and the upper end of the right tibia and fibula—the points at which some of the most interesting of the lesion occur.

Two plates showing the left humerus are dated October 1924 and June 1925. They are un-

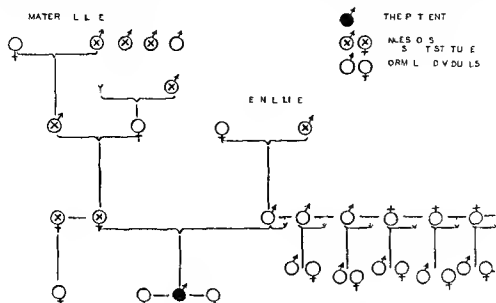


Chart showing familial influences in author's case.

modified a second exostosis that cannot be seen in the original roentgenogram has appeared and grown to an equal size and less regular shape.

The lesions of the left radius and ulna as shown in the old and new plates appear to be identical. The only difference is the presence of a tiny blunt spur of bone that springs from the outer side of the ulna 3 centimeters from its tip and has now entirely disappeared.

One gets the probably correct impression that the bones in the later shadows are longer and a little more slender than in the earlier ones but accurate comparisons are impossible because of the slightly different positions from which the respective plates were made.

The upper part of the right leg shows the general conformation of the head of the tibia to be about normal though probably largely cartilaginous but the head of the fibula forms a great irregular knob of cartilage with trabeculae of bone and echondroses projecting externally anteriorly and internally so as to keep fibula and tibia unduly separated. In the later plate of this region the external projecting echondrosis has almost disappeared and the internal mass has diminished or had its direction shifted so that the bones are almost normal in their approximation.

Unfortunately there were no plates to show the lower ends of the bones so it is not known what may have been the condition of the exostoses if they existed as they probably did—then.

Having learned that the disease seemed to be hereditary in character the patient almost immediately thought of his maternal grand

father as the source of his trouble basing the suspicion on the fact that that ancestor is short in stature with short arms and a general configuration resembling his own. This view of the situation was tentatively accepted and in order to confirm it as nearly as possible the patient consented to persuade his grandfather—now an incapacitated aged gentleman—to have part of his skeleton roentgenographed. Sufficient scientific interest was aroused and the desired end was achieved. The result was however unexpected and disappointing for all examined parts of the skeleton proved to be perfectly normal.

Short stature runs through both sides of the patient's family but it is not dwarfing and though it excites interest in the mind of a student who is trying to trace family relationship in a patient with this commonly hereditary condition may have nothing at all to do with it. All efforts to find definite inheritance or trace positive familial influences in the present case came to nothing.

HISTORY

This subject has been so carefully reviewed by Albert Ehrenfried in three easily accessible contributions that all that seems necessary in the publication of a new case is to refer to his papers, abstract his findings and add any advances to knowledge that have been made since 1917 when his last writings appeared. In summarizing the chief features of the condition under consideration Ehrenfried finds it characterized by

The occurrence of multiple more or less symmetrical cartilaginous or osteocartilaginous growths within or upon the skeletal system generally benign and resulting from a disturbance in the proliferation and ossification of bone

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After considering the various names that have been applied to the condition and the various explanations for its occurrence that have been offered he comes to the conclusion that it is a chondrodysplasia of hereditary or congenital origin accompanied by secondary deformities and elects to name it hereditary deforming chondrodysplasia. Although objected to by a few and therefore not universally adopted that name appears to be well founded both etiologically and pathologically and most appropriate.

From the literature collected and reviewed Ehrenfried concludes that a total of 99 cases have been reported as occurring in the United States. The total number of cases reported the world over in between 350 and 400 articles upon the subject is in the neighborhood of 700.

Of the cases generally recorded in the literature 60 per cent are German 27 per cent French 8 per cent English all other countries 5 per cent. Of the 99 reported American cases there were 6 of Dutch origin 18 of German origin 3 of Irish origin 2 negroes and one each Italian Austrian English French Canadian and mixed French Canadian and English. Of 89 American cases 66 were males and 23 females—a ratio of about 3 to 1.

In the literature prior to 1890 much of which was rather vague Peincke was able to find 36 families in which 172 cases occurred. Of them one showed the condition in five generations two in four generations fifteen in three generations and twelve in two generations. In 34 more recent cases Ehrenfried found heredity to be shown in 176. Of these 174 cases occurred in 42 families. In two families it could be traced through four generations in fifteen through three generations and in twenty one through two generations. In his last paper Ehrenfried cites the interesting family reported by Montgomery in which there were five cases in three generations and one of his own with eight cases in three generations.

The line of descent is more apt to be the paternal than the maternal. Thus Ehrenfried found it transmitted by fathers 35 times by mothers 20 times. One father had affected children by two marriages two mothers had affected children by different husbands. In two cases it was transmitted by unaffected mothers and in two instances it was seen to skip a generation.

Ehrenfried excised a portion of one of the affected bones passing through the epiphyseal junction and studied the lesion microscopically. He says

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Of the secondary deformities he says

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chondral junction Here we commonly have a well defined sarv

The clavicle and spine may show outgrowths as well On the head exostoses sometimes appear on the lower jaw or about the base of the skull The most typical occurrence here is at the spheno-occipital junction small outgrowths (ecchondrosis spheno occipitalis Virchow) been found at this point in most necropsies on chondrodysplastic subjects

Ehrenfried's remarks upon the course and complications of the disease are interesting

Most cases become stationary at about 10 years of age and regress slightly A few cases have febrile attacks but most cases have no symptoms Many never know that they have the disease until rounded up and examined in an effort to determine the heredity in some family Even with considerable deformity function is usually good though a bad valgus is likely to be troublesome

Occasionally a large hyperostosis will impede action or a pointed one cause pain Such have been known to perforate the bladder or a pregnant uterus Many of the projections develop bursæ which may be subject to the same inflammations and enlargements that affect other bursæ There are seven cases on record in which as the result of trauma a large artery—femoral or popliteal—has been torn on the apex of a bony outgrowth causing an aneurysm

There are two cases on record of paralytic club foot from involvement of the peroneal nerve in a hyperostosis and one of fatal spastic paresis from bony growths in the spinal canal and there are a few questionable cases of intra cranial growths

The most frequent and most serious complication is the development of a rapidly growing or malignant osteo cartilaginous tumor in persons affected with this disease Lenormant and Lecne in 1903 collected 24 cases of this nature most of them fatal and the later literature contains about a dozen more which would figure about 5 per cent of the total number of cases The ages at which this malignant development has been noted lie between 11 and 50 years but it usually occurs after the skeletal growth has ceased or between 25 and 35 years

Any increase in the exostoses after the cessation of skeletal growth should be treated with suspicion and surgical steps taken at once excision being carried well into the normal cortex and medulla

Beyond this treatment is indicated only when the removal of a bony growth will facilitate joint function or osteotomy correct a disabling deformity

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PHRENICECTOMY

RALPH BOIRN BITTMAN MD FACS C CHGO

C I Ch W H T b l m A J g Th Mt S H f A so At J g
M I R H p i l n g y N th t L y M f cal b h j

THL indications for phrenicectomy are lesions which may be benefited by partial resection and immobilization of a lung. The lesions include unilateral tuberculosis of the lung especially cases in which the lower lobe is chiefly affected and in which adhesions of the pleura preclude artificial pneumothorax lung abscess and bronchiectasis of the lower lobe of the lung. Phrenicectomy is often done as a preliminary to extra pleural thoracoplasty to see how well the patient will tolerate collapse before the more thorough but more radical operation is performed. Occasionally in plastic procedures in the lower chest diaphragm and oesophagus where the diaphragm itself is used to fill in or cover up a defect its immobilization by phrenicectomy is desirable.

The dangers to be feared either during or after the operation are very few. During the operation carelessness may result in injury to one of the arteries branching from the thoracic axis. The external jugular vein is occasionally cut usually voluntarily and inasmuch as it can be easily ligated rarely can be considered in the light of a complication. Injury to the thoracic duct especially in operations upon the left side occasionally occurs and results in lymphatic drainage from the wound drainage which usually stops spontaneously after a few hours or days. The unskilled operator may injure one of the nerves going to make up the brachial plexus mistaking these nerves for the phrenic nerve. The same can be said of the cervical sympathetic. If the cervical sympathetics are injured a temporary disturbance of function of the muscles of the pupil of the eye on that side may result and occasionally an anisocoria. One danger which exists is that the accessory phrenics in their course to join the main phrenic may pass under the subclavian artery the innominate artery or one of the large branches of a large intrathoracic vein. Cases have been reported in which an uncontrollable haemorrhage has occurred from injury to these vessels during the evulsion of the phrenic nerve. The case is rare. Furthermore the accessory phrenic nerves are usually so delicate that their tensile strength is much less than that of the vessels under consideration and therefore tear first without injuring the vessel. To my mind the more radical operations which have

been devised to avoid the possibility of injury to the vessels entail more risk than the danger they attempt to obviate.

The dangers resulting from paralysis of the diaphragm are nil. It was first thought that paralyzing the diaphragm might interfere with the raising of sputum from the affected lung. This has not proved to be the case. The patient still can cough. In fact frequently one of the first benefits the patient sees from the operation is that the cough is easier. This is due to the abolishing of the diaphragmatic spasm which frequently exists and which makes coughing difficult.

It was also feared that there would be insufficient aeration of the lower lobe of the lung because of loss of diaphragmatic motion and that as a result a hypostatic pneumonia might develop. This also has been shown to be a groundless fear.

The operation is performed under local anesthesia. The patient requires no preoperative preparation outside of cleaning and shaving the neck or in apprehensive patients the administration of a hypodermic of morphine a half hour before operation. There is no need to vary the patient's usual hospital routine nor even to interdict breakfast the morning of the operation. The patient lies upon the operating table in the usual recumbent position with the neck hyperextended by a sand bag placed under the shoulders. The head is turned slightly laterally in what photographers would term a half profile exposing the side of operation. The lateral border of the sternocleidomastoid muscle is usually readily palpated through the skin. The incision should start slightly medial to its lateral border about two and one half fingers breadth above the clavicle and should run directly lateral for a length of from one to two and one half inches depending upon the amount of the patient's subcutaneous fat. The skin and subcutaneous tissues over the site of incision are infiltrated with a few cubic centimeters of one half per cent procaine solution. The incision is made through its entire length with a single sweep of the scalpel as in a gonior operation so that the resultant scar will not be marred by the nicks of hesitation. In cutting through the subcutaneous tissues one may find it necessary to cut and ligate the

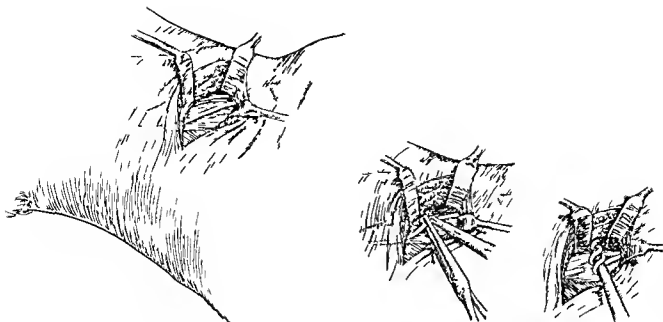


FIG. 1. Step in author's technique of phrenicectomy.

external jugular vein but as a rule the vein will be found to lie lateral to the incision. A tough fascia is next encountered. A few drops of procaine solution should be injected through the fascia into the tissue below it and then with care this fascia is cut in a direction parallel to the previous incision. Under this fascia lies a pad of fat. If the finger is now inserted into the depth of the wound the scalenus anticus muscle can be readily palpated. This muscle is now exposed by careful blunt dissection. I prefer using for this dissection the well known Mayo dissecting scissors. It is during this stage of the operation that a careless operator can injure some of the large vessels coming from the thyroid axis.

As soon as the scalenus anticus muscle is exposed a search is made for the phrenic nerve which lies under a thin integument that covers this muscle. The phrenic nerve is readily recognized by the direction it takes in crossing the scalenus anticus muscle. Instead of coursing in the direction of the nerves which make up the brachial plexus that is slanting from above inward to below outward the phrenic nerve first appears on the outer border of the scalenus anticus muscle, crosses the scalenus anticus muscle downward and inward finally to disappear into the anterior mediastinum over its inner border. This direction is so different from that of any other nerve that there should be no question whatsoever in the mind of the operator whether or not it is the phrenic nerve which he has exposed. The phrenic nerve itself varies in thickness from a nerve about the size of the lead to the

average lead pencil to one the size of a piece of woolen yarn. If any doubt still remains as to the identity of the nerve which has been exposed a very simple procedure can be used to remove all question. If the phrenic nerve has not been anesthetized and is pinched with a pair of tweezers the patient will frequently complain of a twinge of pain in the region of the homolateral shoulder blade or the patient may hiccough.

After having established definitely the identity of the phrenic nerve a few drops of procaine solution are injected into the nerve itself. The nerve is then grasped with a tissue forceps and cut near the upper outer border of the scalenus anticus muscle. The proximal cut end should be observed for a moment or two for possible hemorrhage from a small concomitant blood vessel. The distal cut end is then firmly grasped with the hemostat and pulled upward into the wound. With another hemostat a firm grasp is then taken on the nerve and the nerve slowly evulsed by wadding it upon the second hemostat. The evulsion should be slow and steady—a half turn of the hemostat every five or ten seconds is made until several inches of the phrenic nerve have thus been evulsed. Some operators continue the evulsion until the phrenic itself is torn loose others are satisfied in cutting the phrenic nerve after from two and one half to three inches of nerve have been evulsed. The wound is inspected for bleeding. None being found it is closed with two or three subcutaneous sutures of No. 0 or No. 00 catgut and an intracuticular suture of silkworm gut, no drainage being neces-

sary. A small gauze pad is placed over the wound held there by adhesive and the patient returned to his room. Examination with a fluoroscope will confirm the paralysis of the diaphragm. The diaphragm on the side operated upon will be found to lie in a higher position than on the other side and to be practically immobile during the phases of respiration. Very frequently a paradoxical motion will be seen that is during inspiration the paralyzed side will actually rise into the thoracic cavity to drop back again during expiration. It is not until several weeks or even months after the operation that the diaphragm assumes its final most elevated position. In this case it rises from one and one half to two inter spaces higher than normal reducing the thoracic cavity to the equivalent of about 400 to 500 cubic centimeters.

After the operation the patient may within a few hours return to his previous hospital regime. No pain will be experienced and there is no particular reason as a rule to keep the patient in bed or forbid eating. For hypersensitive patients a sedative may be required because of the skin incision but this is usually not necessary. In fact ordinarily especially in those cases who have had

paroxysms of coughing before operation the patient will either have no discomfort whatsoever or will actually feel immediate relief. After the fourth or fifth day the intracuticular stitch may be removed and if the wound is closed dressing may be dispensed with.

The benefits of operation can usually not be estimated for several months. In some cases of bronchiectasis for example which improve after phrenicectomy the sputum at first may be even more copious than before and only gradually diminish. The same may apply to some cases of lung abscess. In other cases the improvement sets in early and the sputum and febrile reaction if there is any subsides almost as if by magic. In those cases of pulmonary tuberculosis in which phrenicectomy has been performed as an experimental procedure to test out the patient's tolerance before performing the operation of extra pleural thoracoplasty the results can usually be seen within a short time. If the tolerance is poor an increase in the afternoon temperature an increase in the number of tubercle bacilli found in the sputum and often an aggravation in symptoms may be noted within a few days after the operation.

THE TANNIC ACID TREATMENT OF BURNS IN CHILDREN

ALBERT H. MONTGOMERY, M.D., CHICAGO

THE importance of having a satisfactory treatment for burns is at once apparent when we recognize the high mortality and the prolonged and deforming morbidity that accompanies this group of injuries. From a perusal of the surgical literature it is plainly evident that almost up to the present time there has been no unanimity of opinion as to what constitutes the ideal or even the best treatment for burns. The number and variety of the methods that have been advocated from time to time tend to substantiate this fact.

In the treatment of burns we have a complex situation in that several factors have to be controlled. The treatment must aim (1) to stop pain (2) to prevent toxæmia (3) to insure asepsis (4) to prevent the loss of tissue fluids and (5) to prevent contractures and scar formation. As these are the factors that govern the mortality or morbidity it is evident that the value of a given treatment must be judged by its power to control these factors. Naturally most of the methods that have been used have had some success in controlling one or more of these points; the ideal treatment is the one that is able to control all of them.

The treatment of burned patients usually consists of systemic and local measures. Practically all of the methods employed make use of the same systemic treatment. Briefly this consists of morphine to relieve pain and shock, glucose and alkaline solutions to supply body fluids and combat toxæmia. In some instances blood transfusions have been given. Exsanguination followed by transfusion has been suggested. In the local treatment of burns the various methods employed fall essentially with these groups.

1. The biochemical or alkaline treatment. This consists of the application of a sterile 10 per cent solution of bicarbonate of soda either as a continuous wet dressing or if the burn is extensive the patient may be kept in a warm soda bath for hours or days. This method is soothing and fairly efficient but it is rather cumbersome. However in the burns of children this method is most valuable as a first aid home remedy. It is simple to apply and the necessary materials are found in every household.

The protective method or paraffine treatment. The principle underlying this method is that of protecting and splinting injured tissue to stop pain and to permit restitution to take place.

To accomplish this the burned area is sprayed or painted over with hot melted paraffine and then covered with cotton or gauze which is covered with paraffine. The original compound called ambra which popularized this treatment consisted of a mixture of

| | |
|----------------|----------|
| Resorcin | 1 part |
| Oil eucalyptus | 2 parts |
| Olive oil | 5 parts |
| Soft wax | 5 parts |
| Hard wax | 67 parts |

Theoretically this dressing should not require changing if the area is sterile but usually the amount of discharge from the wound surface necessitates several changes of dressings.

3. Fixation methods. The principle on which this mode of treatment is based is that of healing a wound under a crust. For this purpose antiseptic drugs which have a desiccating and fixing action on the tissue cells are sprayed or painted over the burned area or dressings continually moistened with these drugs are applied. To hasten drying and crust formation evaporation is encouraged by open dressings.

The drugs that have been used in this method of treatment are absolute alcohol, aluminum acetate, picric acid and tannic acid.

Dressings kept continuously saturated with absolute alcohol give remarkably good results. However because of rapid evaporation this method requires a great amount of attention and if the area involved is large the expense is considerable. Nevertheless as it produces a minimum of scar tissue alcohol is valuable in treating burns of the face.

Aluminum acetate consists of a 1 per cent alcoholic solution of aluminum acetate mixed with a 2 per cent solution of methylene blue in a preparation of 10 parts of the aluminum solution to 1 part of the methylene blue solution. This aluminum acetate solution is sprayed on the wound, a light gauze dressing is applied and drying is encouraged.

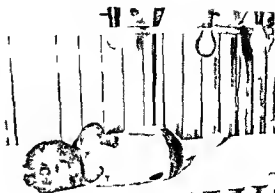
A one per cent solution of picric acid in 5 per cent alcohol is applied in the same manner as the aluminum solution. This method gives good results and it has been very popular. Its disadvantages are the yellow stain that it imparts to the linen that comes in contact with the dressing and more important the poisoning that may occur from drug absorption.



I Appl at f pl t

The use of tannic acid was introduced by Davison in 1925. His method consisted in the use of a 5 per cent ferrihydric prepared solution of tannic acid in water applied on sterile gauze over the wound. The dressing is moistened every hour with this solution. The wound is inspected through a small opening in the dressing at the end of 1, 2, 3, and 4 hours. As soon as the wound surface is well tanned as shown by a dark brown color the dressing is well moistened and carefully removed. The dry tanned coagulum that now covers the wound is left exposed to the air. To protect the area from mechanical injury bacterial invasion or chilling a sterile linen cage is placed over the wound area. If the burn is superficial epithelialization will proceed under the dry coagulum; if the burn is deeper the tanned crust will separate between the fourteenth and twentieth days leaving a clean granulating surface.

Davison based his treatment on the theory that the toxin present in the red cells was due to the absorption of the products of protein autolysis at the site of the burn. In order to limit this absorption he produced a coagulum of the devitalized tissues only by the application of tannic acid. The dry crust thus produced prevented the loss of tissue fluids which lead to a lowering of the



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mth d th f l p t d y th nd ff ppl

sodium chloride of the blood. He obtained in that way a marked lessening of the toxæmia.

In addition the tannic acid applications produce a definite analgesia and did not affect the normal skin. In the burned area islands of epidermis from hair follicles and skin glands are preserved. Scarring is avoided by the dry coagulum which forms an unfavorable nidus for bacterial growth.

In my experience with this method in children I have proceeded as follows:

Immediately on admission the patient is given a dose of morphine sufficient to control pain. The skin about the burned area is carefully cleansed with Iodine or ether and gross particles of dirt





Fig. 5 Patient on whom 5 per cent tannic acid treatment had been used



Fig. 6 Patient with extensive burns on back and buttocks showing the advantages of this treatment

are removed with sterile instrument. A 5 per cent solution of tannic acid is then sprayed over the wound. This solution should be freshly prepared as it turns to gallic acid on standing. With out clothes or dressings of any kind the child is placed in bed on a sterile sheet. Any necessary splints or suspension apparatus for the limbs are then applied (Fig. 1). Blankets are placed to form a tent over the bed with one or two electric lights suspended from the roof for warmth and drying purposes (Fig. 2). Fluids are forced by mouth or given by hypodermoclysis or proctoclysis. In the more severe cases glucose solutions or blood transfusions are given intravenously. Every half hour the wound area is sprayed with the tannic acid solution but no dressings are applied. After the first half hour the wound becomes painless and remains so. In from 15 to 24 hours depending on the depth of the burn a dry brown crust smooth like a piece of leather has formed over the wound (Fig. 3). This heavy dry crust completely seals the wound and is insensitive. The child is kept under the tent and no further local applications are made. At the end of 3 or 4 days all evidences of toxæmia usually disappear. Locally if the burn is superficial the crust begins to loosen at the edge as epithelialization goes on and the loosened portion can be cut away with scissors (Fig. 4). In the deeper burns the crust usually loosens in from 2 to 3 weeks leaving a clean granulating surface which can be prepared for skin grafting by wet dressings of saline or Dakin's solution. If evidences of sepsis arise at any time holes may be made in the crust for the application of Dakin's solution or the entire crust may be removed by softening it with vaseline. It has been found however that if wet dressings of boric acid are used a rapid toxæmia arises that is frequently fatal.

I have altered the method of Davison in applying the tannic acid by omitting the use of gauze dressings. When the coagulum was produced under gauze it was sometimes difficult to remove

the dressing as the gauze tended to adhere to the wound in places. By using the spray no dressings are necessary.

The solution advised by Davison was a 2.5 per cent strength but he stated that a solution up to 5 per cent could be used. I have found that a 5 per cent solution produces a coagulum more rapidly and does not seem to affect the uninjured tissue. Also for burns about the face Davison suggested the use of a 5 per cent tannic acid ointment. I have tried this but it did not seem to act as satisfactorily as the 5 per cent solution applied as a very fine spray (Fig. 5).

SUMMARY

I used this treatment in 24 cases in children with two deaths both of which were due to pneumonia and occurred in infants about 10 months of age. In common with Gordon Seeger, Fraser, McCullough, Beck, and Powers I feel that this method is a real advance in the treatment of burns and more than any other method it has reduced the mortality figure. Bancroft and Rogers have recently reported a mortality of 10 per cent in 114 cases. By the prevention of infection scar formation is reduced to a minimum as skin grafting can be done very early if epithelialization does not occur spontaneously.

The practical absence of pain by the analgesia of the tannic acid and the complete freedom from dressings is a joy not only to these children but to the surgeon who has to look after them. In the rather frequent burns about the buttocks and genital region that are so difficult to dress and keep clean the advantages of this method are very apparent (Fig. 6). There are no large weeping wounds as the dry coagulum prevents the loss of body fluids. In the same way toxæmia is distinctly lessened by the coagulation of the devitalized tissue which prevents absorption of toxic products.

In conclusion it would seem that by controlling all of the factors required in the treatment of burns the tannic acid treatment where applicable is ideal. In addition the treatment is inexpensive as tannic acid is cheap. The solution can be readily made by adding one half a teaspoonful of tannic acid powder to an ounce of water. As the powder keeps readily it should be placed in all emergency outfits. For obvious reason this treatment should be of decided value to industrial surgeons. Wherever possible the tannic acid solution should be employed at the first treatment for we have found it is very difficult to secure a good coagulum and keep the burned area aseptic if some other form of treatment is used before the tannic acid is applied. I feel that here as in many

other places in surgery it is the man who first sees the patient and applies the first treatment that determines the ultimate outcome in that particular case.

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6
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PROLAPSE OF THE RECTUM IN CHILDREN

JOHN J COBLETT MD FACS DE ROY MICHIGAN

PROLAPSE of the rectum is generally accepted as a descent with or without protrusion of one or all of the coats of the rectum. The variety usually encountered in children is the incomplete or partial prolapse. It is an exaggeration of the normal eversion of the mucous membrane which occurs at every bowel movement. Normally the loose connective tissue in the rectal wall stretches somewhat to facilitate the ejection of feces and then contracts again. When this tissue is not normally elastic the mucous membrane protrudes farther than normal and is not drawn back. Persistence of the partial prolapse drags upon the fibrous and elastic attachment of the mucous membrane to the muscular wall and eventually pulls the entire wall downward thus producing a complete prolapse.

There are several predisposing causes. One of the commonest is relaxation of the sphincter and an absorption of the perirectal fatty cushions which normally surround the lower end of the rectum and anal canal. Todd has shown that the infantile rectum lies on a lower plane than do the other pelvic organs which in their descent exert a downward pressure on the rectum. This anatomic arrangement combined with the effect of the nearly vertical childish sacrum will account for many prolapses in children.

There are many exciting causes. Riclets summer diarrhoea dysentery and other exhausting

diseases by reason of the weight loss and the lowering of general tissue tone which they produce frequently initiate a prolapse. In diarrhoea a reciprocal relation or a vicious cycle must be considered. Rather than diarrhoea causing prolapse the latter condition may be the cause of the former. In fact there is reason for believing that prolapse is more frequently responsible for diarrhoea than diarrhoea is responsible for prolapse. Prolapse is especially likely to cause a persistence of diarrhoea when the mucous membrane is excoriated and inflamed. Most infants strain violently with bowel movements. Hard stools polyps phimosia and diarrhoea may cause unusual straining efforts and precipitate a prolapse.

Many authors assign as the most prolific source of prolapse the practice of compelling children to sit on the stool until their bowels move. This is a well established habit in the modern household. It is a question whether or not a normal child without predisposing cause would develop prolapse from this practice.

In the beginning prolapse is associated with very few symptoms. An exaggeration of the protrusion of the mucous membrane occurs normally at stool. This protrusion gradually increases in size until it is perceptible and annoying. At first the prolapse is reduced spontaneously or recedes under gentle pressure. As the protru-

sion increases the sphincter muscle grasps it more firmly and reduction becomes increasingly difficult. The frequent protrusion gradually overstretching the sphincter so that tonicity is markedly reduced. In view of this relaxed condition and a persistent peristalsis associated with irritation of the rectum incontinence often exists. The discharge of mucus and liquid stools frequently irritate the surrounding skin and cause pain or discomfort. Children with prolapse dread every bowel movement postponement results in altered metabolism and constitutional disturbance.

The diagnosis of prolapse can be made easily. However it is surprising to see how often prolapse is diagnosed as hæmorrhoids. The latter occur very rarely in children. Occasionally a large polyp may present itself at the anus, and be confused with partial prolapse. Polyps are often seen in children. In the effort to expel them an actual prolapse may develop. A prolapse may be of any size from that of a walnut to that of an orange and not infrequently protrudes 3 to 4 inches. The mother often states that the mass which protrudes looks like a small red apple. A prolapse apparently surrounds the anus without division into definite tumors. First the color is like normal mucous membrane. Later it becomes red with irritation and sometimes purplish with congestion. When chronic the surface is covered with patches and strings of mucus. The soft velvety feeling is lost and the tissues feel thick and boggy; it becomes friable and is very easily torn.

The first consideration in the treatment of prolapse in children is to maintain the organ in its natural position while the general constitutional condition and muscular tone are being restored to normal. Immediate treatment of prolapse is often necessary. If the prolapsed tissues have been exposed for a considerable time there may be swelling and œdema. Gradual and continued pressure with hot compresses may frequently give comfort and at the same time reduce the mass.

An easy method of reduction is to cover the finger with a piece of toilet paper introducing it into the lumen of the mass forcing the finger carefully into the rectum immediately withdrawing. The dry paper adheres to the mucous membrane and releases the finger. The toilet paper softens and is expelled with the next bowel movement. The child should be kept upon its face for a short time thereafter.

When prolapse is the result of exhausting diseases as summer diarrhoea dysentery and

rickets one will obtain the best results by first combating these conditions. Cod liver oil general tonic treatment and a proper diet are important. Compresses for supporting a prolapse are not satisfactory. Pressure thus produced dilates and relieves the sphincter aggravating the condition. Frequently various types of rectal plugs and freak harnesses are used. They defeat their purpose by dilating the sphincter. Broad strips of adhesive passed anteriorly to anus and from one trochanter to the other so that they do not interfere with defæcation will serve well for temporary support. These can be changed every 10 to 12 days without causing too much skin irritation. In addition local applications which stimulate contraction of the sphincter muscle and retraction of the prolapsed gut should be made frequently. Cold water is one of the best of such applications.

To prevent the occurrence of prolapse during bowel movement the child should be required to defæcate in the dorsal position into pads of cotton. These movements should be expedited and straining minimized by an enema administered in the proper position. It is important to keep the stools soft and the rectum lubricated. This is best accomplished by the administration of mineral oil and by giving an increased quantity of fruits, vegetables and fluids. It is true that prolapse in children can often be cured by careful study of the patient, the regulation of the diet, the removal of sources of irritation if any exist, the control of diarrhoea or constipation, the strapping of the buttocks and the administration of cod liver oil or some other tonic. After apparent cure careful and prolonged observation is necessary in the prevention of recurrence. Such management is laborious and often impracticable. Some cases do not yield to these conservative measures and demand more radical treatment.

For the treatment of prolapse which has not been relieved by palliative measures and medical treatment many radical methods have been devised. Some of these are formidable operative procedures such as partial or complete excision of the prolapsed tissues, excision of elliptical sections as in hæmorrhoidectomy, clamp and cautery suturing through the rectum and around the coccyx. Both Tuttle and Mummery have resorted to scarification between the rectum and the sacrum with packing of the ischio-rectal fossæ. Thiersch passed a silver wire subcutaneously around the anus. Plenz inserted fascial strips taken from the thigh around the anus. The literature contains many reports of poor results from these radical procedures. Weber in Leipzig

reports recurrence of prolapse in 17 per cent of patients treated by coloproxy and in 61 per cent treated by running a silver wire around the anus. Some report good results from the application of nitric acid, the actual cautery, and the injection of various irritating fluids such as phenol, alcohol, and quinine and urea hydrochloride. Tuttle objected strenuously to the use of nitric acid, stating that the burns could not be controlled and produced deep sloughs and hæmorrhage with resulting stricture. The difficulty with the injection of irritating fluids is that the extent of the inflammation in the submucosa cannot be controlled.

Findlay and Galbraith have reported treatment of 41 children by injection of absolute alcohol into the submucosa. They report 90 per cent of their cases cured, although in several cases it was necessary to repeat the treatment once or twice. A general anæsthetic was used in all treatments.

Following the publication of Van Buren's book, approximately 50 years ago, linear cauterization has been used sporadically by different men in different parts of the world. Cauterization sets up an inflammatory reaction in the submucous tissues directly beneath the line of application. In the organization of these inflammatory areas there is a development of fibrous tissue which firmly binds all coats of the rectal wall to its surrounding structures. A search of the literature did not reveal any series of more than a few cases in which this treatment was employed. Why this excellent method has never come into general use is not obvious to the writer.

In 1920 at the Children's Hospital of Michigan an 8 year old girl who had been subjected to several operations for prolapse came in with a recurrence. In the last operation a wire suture had been inserted around the anal orifice. An abscess had developed and in addition to prolapse the child presented a fistula. The fistula was excised and linear cauterization was done. The result was perfect. Encouraged by the outcome of this difficult case we have employed this treatment in 8 to 10 cases each year, this being about half the total number of prolapse cases observed in this clinic.

TECHNIQUE

The technique as used at the Children's Hospital may be described as follows:

Under ether anæsthesia the rectal wall is brought out as far as possible with Pennington triangle forceps attached anteriorly, posteriorly and laterally. The mucous membrane is carefully dried. Then with a narrow Paquelin cautery

four linear longitudinal incisions are made through the mucous membrane extending up to but not into the anal canal. Care must be taken not to penetrate the rectal wall, especially anteriorly. The prolapsed tissues are then gently replaced. A rubber tube is encircled with a two-inch bandage forming a plug approximately 3 centimeters in diameter. This is well lubricated with an ointment made by mixing 2 drams of soda bicarbonate with 1 ounce of vaseline. This lubricated plug is inserted into the rectum and is kept firmly in position by adhesive plaster which is passed completely around the body at the level of the trochanters. If this precaution is not adopted the severe straining of the child coming out of the anæsthetic will force the plug out and the bowel will again protrude. When the plug is properly applied the straining soon ceases and the child complains of little or no pain. The knees are firmly bound together with a bandage to prevent standing and spreading of the buttocks which might release the tube. The plug is removed in 48 hours. By this time there has been an outpouring of inflammatory products into the submucosa producing a swelling which in itself prevents extrusion of the rectum. It is remarkable but true that these children do not require postoperative opiates. There is apparently very little discomfort following the operation. After the tube has been removed a small soda enema is given.

The child is usually able to leave the hospital in one week, and the mother is instructed to see that all bowel movements for 3 weeks are passed in the dorsal position. Small doses of mineral oil are given daily. The patient is returned for examination in one month.

Sixty-two children ranging in age from 3 months to 11 years have been treated in this fashion. In 12 cases (19 per cent) the prolapse had been present for less than 1 month; in 18 (29 per cent) for more than 1 year; and in 1 case (1.6 per cent) for 11 years. This last patient frequently was forced to leave school or play for reduction of the prolapse.

One child 3 months old not included in this series presented a history of prolapse for a period of 4 days before admission. Examination disclosed a mass 6 inches long retracted toward the scrotum. Efforts to reduce the mass were futile. The child lived 6 hours after admission to the hospital. An autopsy revealed that the rectum, sigmoid descending colon and the left half of the transverse colon had prolapsed. A loop of jejunum 15 centimeters in length was twisted into the sac formed by the prolapse of the sigmoid.

This case demonstrates that a simple prosthesis if neglected may be followed by very serious developments. It was necessary to repeat the cauterization on just one patient. This was probably due to inadequate cauterization. In the remaining cases only one treatment was necessary to obtain a cure and to date there have been no recurrences.

In 38 (61 per cent) of these cases the condition

2 years after the operation was determined. Frequent rectal examinations have not demonstrated any stenosis, scars, indurations or other untoward results. Operation has been avoided when a child had fever or respiratory infection of any type. There were no cases of postanæsthetic chest infection. The results which have been obtained in this series of cases justify the presentation of this work.

CORRESPONDENCE

SPINAL ANÆSTHESIA IN THE TREATMENT OF PARALYTIC ILEUS—1 *Correction*

To the Editor It has been called to my attention that there is an error present in my paper entitled "Spinal Anæsthesia in the Treatment of Paralytic Ileus" which was published in the December 1928 issue of SURGERY, GYNECOLOGY AND OBSTETRICS. Through an oversight on my part the amount of novocaine solution used has been given as 0.3 gram instead of 0.1 gram.

W. E. STUDDIFORD, M.D.

New York

EIGHTH CONGRESS OF THE SOCIÉTÉ INTERNATIONALE DE CHIRURGIE

The Eighth Congress of the Société Internationale de Chirurgie will meet in Warsaw, Poland, July 23 to 26, 1929. A most interesting program which will include speakers from many countries of the world is being prepared.

Further information and preliminary announcement may be obtained by addressing Dr. L. Mayer, secretary general of the society, 72 Rue de la Loi, Brussels, Belgium.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARSH, M.D.
ALLEN B. KAY, M.D.

Managing Editor
Associate Editor

WILLIAM M. MOORE, M.D.

Chief Editorial Staff

FEBRUARY 1979

BLOOD CHLORIDE DEPLETION

AN appreciation of the dangers of blood chloride depletion is of importance in the treatment of many surgical conditions.

In the past surgeons have stood by after a successful operation for the relief of intestinal obstruction and watched the patient die from what was called toxæmia but what really was a condition known as alkalosis due to blood chloride depletion. Whether such depletion is due to a combination of chloride with the toxin produced or to an excretion of chloride into the intestinal lumen or failure of absorption due to loss of hydrochloric acid by vomiting is an unsolved question. Even if the blood chloride depletion is a result rather than a cause of the toxic postoperative condition one must feel after observing these cases that the diminution of blood chloride is an indication of the severity of the condition. Our attention was first called to this condition some years ago when we reported a series of cases of uraemia following gastroenterostomy. We know now that the blood chloride depletion was the important factor and that

the condition was one of alkalosis. Our subsequent impression was that the chloride depletion was due to loss of hydrochloric acid by vomiting but subsequent laboratory work has proved this view to be fallacious. The exact mechanism responsible for this condition is still a fertile field for investigation.

Many surgical conditions are characterized by marked chloride loss: the various fistulae, gastric and duodenal and the obstructions, functional and mechanical of the stomach and bowel. The successful preoperative and postoperative treatment of such cases demands among other things and not the least important a knowledge of the condition of the blood chlorides. For many years surgeons have been giving salt solution empirically to replace the fluid loss when the important thing was not only the fluid loss but the chloride depletion.

The laboratory tests necessary for such knowledge are well within the range of the ordinary laboratory and should not be neglected. Without such knowledge one runs the risk of not fully supplying the patient's need.

Normally the blood contains between 500 and 600 milligrams for each 100 cubic centimeters of blood. Under the conditions present in intestinal or gastric obstruction the blood chloride falls as low as 300 milligrams. This loss turns the tide of neutrality of the blood toward alkalinity with a lowering of the blood chloride, a rise of the carbon dioxide combining power and an increase of the nonprotein nitrogen.

Credit must be given to Haden and Orr for bringing this condition of alkalosis to the

attention of the medical profession. It has been found that whereas in former years great stress was laid on the condition known as acidosis this change aside from the surgical diabetic and nephritic cases seldom takes place. The condition known as alkalosis is more common than acidosis and just as serious in its outcome. The symptoms of both are very similar hence the importance of differentiation because treatment for acidosis would be very dangerous for the patient with alkalosis. Tests for the blood chloride as well as non protein nitrogen serve to differentiate the condition.

Treatment for alkalosis is comparatively simple. Salt solution in 3 per cent dilution intravenously as well as subcutaneously can be given in such amounts as to raise the blood chloride to normal. We have not found in our experience much change in the blood chloride by rectal administration of saline solution. In the giving of this solution it is better to give too much rather than too little. As high as 6 liters can be given in 24 hours without harm.

Attention to this condition in the pre operative and postoperative care of gastric and intestinal obstruction cases will result in better surgical results. W J TUCKER

FIVE ESSENTIAL FACTORS IN THE TREATMENT OF ACUTE INTES TINAL OBSTRUCTION

ACU TE intestinal obstruction cannot be treated logically unless the following factors are taken into consideration and their relative importance properly evaluated in each patient: removal of the mechanical obstruction; drainage of the obstructed intestine; relief of toxemia; relief of dehydration; and prevention of starvation.

It is obvious that a cure in intestinal obstruction cannot be obtained without removal

of the obstruction. Just when an effort to release the obstruction by operation should be attempted is in some cases worthy of careful consideration. In the very early cases in which operation may be done before the patient is toxic the obstruction can be relieved with comparative safety. If however the patient is much dehydrated and toxic pre operative treatment with water and salt is imperative. The surgeon must then choose carefully between an operation to remove the obstruction and a temporary enterostomy to drain the obstructed gut.

Unquestionably in the extremely toxic patient with obstruction of the small intestine enterostomy frequently gives relief. Whether the enterostomy should be an ileostomy or a high jejunostomy may be a question worth considering in the light of recent results obtained by experimental drainage of the upper jejunum. Dogs die very quickly with upper jejunal drainage and the blood chemical changes are similar to those found in high intestinal obstruction. Walters and Bollman have recently called attention to the serious toxemia which develops from duodenal fistula. It is entirely possible that prolonged high jejunal drainage may be harmful. In spite of many recommendations for high drainage of the jejunum it seems safer to recommend the drainage of the distended small intestine at a point where it is most easily accessible. If this is done in conjunction with the treatment which will be outlined later success may be expected in a large percentage of cases. In those cases with enormously distended gut and with complete loss of peristalsis failure of complete drainage may be expected since in such cases it is likely that only a small segment of the bowel will be drained. The non operative drainage of the upper intestine and stomach with a duodenal tube may prove valuable but can

hardly be expected to render the same service as drainage of the gut nearer the obstruction.

The toxæmia developing in obstruction of the small bowel should receive careful treatment. It seems clear that the administration of sodium chloride has a tendency to relieve the toxic symptoms. Since a definite reduction in the blood chlorides exists in a patient ill with obstruction of the small intestine it is quite logical to supply this salt in a quantity sufficient to restore the chlorides to normal. Abundant proof has now been presented that sodium chloride has a definite therapeutic value in this condition and has a definite tendency to restore to normal the abnormal chemical changes found in the blood. The conclusion may then be drawn that sodium chloride has a definite effect upon and is of value in combating toxæmia.

The observation of Hughson and Scarff that a hypertonic solution of sodium chloride stimulates peristalsis must be taken into consideration. It is quite possible that sodium chloride increases the tone of the bowel muscle and aids in overcoming or inhibiting the distention and paralysis. In extremely toxic patients physiologic sodium chloride solution does not contain sufficient salt to restore the body chlorides rapidly. The intake of salt may be rapidly increased by giving a 2 per cent solution by hypodermoclysis and a 3 or 5 per cent solution intravenously. The solution should be given slowly so as to prevent pain and possible sloughing as a result of the first method and to prevent damage to the blood elements as a result of the second method.

The relief of dehydration must go hand in hand with the relief of the toxæmia. The chemical processes of the body are not expected to function properly without a sufficient supply of water. In patients who are very ill with intestinal obstruction 4 to 6 liters should be given every 24 hours sub-

cutaneously intravenously and per rectum until the patient is beyond the danger point. Criles dictum to "water early, water continuously, water late" should ever be kept in mind. The condition cannot be treated logically without maintaining water balance.

Supplying food is of less importance than supplying water and sodium chloride. Its importance should, however, be recognized especially if the patient has been ill for several days. The reason for the administration of food needs no discussion. Since patients with intestinal obstruction cannot take food by mouth it is best given as glucose intravenously. It has been estimated that man can utilize 0.8 to 0.9 grams of glucose per kilo gram of body weight per hour for an indefinite period. Insulin may be given to aid in the utilization of glucose. By giving glucose very slowly in solutions of 10 to 5 per cent much food can be supplied as the dehydration is treated. The average patient weighing 70 kilograms could, according to this estimate, tolerate an average of 60 grams of glucose per hour without its overflow in the urine. This quantity of sugar is equivalent to approximately 40 calories. It is readily seen that a substantial quantity of food may be given a patient as glucose during a 24 hour period. By the use of a combined 1 per cent sodium chloride and 10 per cent glucose solution both forms of treatment may be given together advantageously.

The five essential points in connection with the treatment may be summarized as follows:

1. Operation to release an acute intestinal obstruction should never be attempted without preliminary treatment when a patient is very toxic and dehydrated.

- In a large percentage of cases of intestinal obstruction with toxic symptoms enterostomy should be substituted as a temporary procedure before an exploratory operation.

attempted to find and relieve the obstruction

3 No surgery should be done in toxic cases before the toxæmia had been treated by the administration of sodium chloride

4 Dehydration and toxæmia are treated simultaneously by the giving of large quantities of sodium chloride solution

5 As long as nourishment cannot be given by mouth glucose solution should be given daily to furnish food

THOMAS G ORR

PAN PACIFIC SURGICAL CONGRESS

THE first international surgical congress to be held in the Pacific has been called by the Pan Pacific Union of Honolulu and will meet there August 14 to 4 19 9

The United States government has invited through the Department of State twenty countries to participate representing thirty separate states exclusive of the states and territories of the United States all of which border on the Pacific Ocean The Province of British Columbia will represent Canada and Washington Oregon and California will represent the United States

The United States will also be officially represented by delegates from the Army Navy Philippines Canal Zone Alaska universities and surgical societies of the Pacific Coast States and the American College of Surgeons Great Britain will have delegates from Canada Australia New Zealand Fiji Federated Malay States, Straits Settlement British Samoa Hongkong and India This shows very strikingly the extent of Anglo Saxon influence in the Pacific region

English will be the official language of the Congress but the transactions will be fully translated and published by the *Pan Pacific Union Journal and Press*

There can be no question as to the value of this meeting from an international viewpoint

Every effort is now being put forth to develop a feeling of amity and mutual understanding between the peoples of the Pacific Honolulu is the crossroads geographically for all the merchant lanes across the Pacific and is a happy choice for such a meeting

The Pacific Coast surgeons who have the honor of presenting American surgical ideals and technique have a great opportunity at this time to carry forward the ideals of American surgery In choosing the men to represent American surgery the committee has been limited to those surgeons who by affiliation with the large surgical societies have been given approval by their associates and co workers The scientific exhibits will be entrusted to the three large medical colleges on the Pacific Coast

Hospital standardization covering every phase of hospital activities from the selection of a site to the completed institution operating as an efficient economical unit to render prompt service to the patient will be offered as America's greatest contribution to the development of surgery This will be presented by the American College of Surgeons at the request of the surgeons of Hawaii

With such a program representing American teaching institutions surgeons and hospitals the surgery of America will be well presented to the visiting surgeons from the Orient South America Australia and North America

In behalf of the officers of the Pan Pacific Surgical Conference may I extend to the readers of this Journal a cordial invitation to be present at the forthcoming Conference to be held in Honolulu August 14 to 4 1929 Full particulars regarding the meeting may be had by addressing George W Swift M D general chairman Pacific Coast States and British Columbia Seattle Washington

GEORGE W SWIFT

MASTER SURGEONS OF AMERICA

JOHN VAN REED LYMAN

JOHn Van Reed Lyman was a man who first by nature and later through environment was not destined to occupy the lime light in the popular sense of the term. The halo which ultimately illumined this humane gentle manly honest scientific and sacrificial man was not of the high powered far carrying type. The radius over which it cast its rays was comparatively short. These rays were however of a compensating intensity.

The lineage of Dr. Lyman can be traced back to Thomas Lyman who lived in England in 1275. His first ancestor to reach America's shores was Richard Lyman who migrated from Norton Mandeville Parish of Onger Essex County England in 1631 and located at Charleston Massachusetts. Twenty six members of the fifth and sixth generations fought for our independence in the Revolutionary War. The generations in line of descent from Richard were John Moses I Moses II Elias Timothy I Timothy II and Timothy III who was the grand father of Dr. Lyman. He married Experience Bardwell and resided at Chester Massachusetts. He died at fifty two. Timothy IV Dr. Lyman's father was born August 28 1819 graduated from Amherst College in 1844 and was ordained in the Congregational ministry in 1850. For fifteen years he was engaged in missionary work in the south and west. He was pastor in Killingworth Connecticut from 1866 to 1869 and died at Bar Harbor Maine at the age of 67. He married Valeria Van Reed Rhinehart June 15 1854. Three sons were born William Bardwell who graduated from Rush Medical College in 1880 became prominent in his profession in the practice of medicine at Eau Claire Wisconsin and is now in practice in Boise Idaho Timothy now practicing in Sacramento California and John Van Reed who is the subject of this sketch.

Dr. John Van Reed Lyman was born in North Pepin Wisconsin January 13 1857 received his academic education at Fort Madison Iowa where he graduated in 1873. He engaged in mercantile pursuits until 1876 when he began the study of medicine and later was appointed hospital steward in the penitentiary where he enjoyed rare clinical advantages. In 1877 he attended the St. Louis Medical College and the following two years he studied at Rush Medical College from which he was graduated in 1880 obviously better prepared than were most of the medical graduates of that period. He at once located in Eau Claire



JOHN V LYMAN
1857-19 6

Wisconsin, a thriving lumber town and there continued to practice medicine until his death which occurred in a hospital in Wauwatosa Wisconsin on March 31 1926

In 1881 he married Maud Kepler and to them were born two children Valeria (deceased) and John Van Reed Jr

On August 7 1909 Dr Lyman married Harriet Sylvester who with a son Richard now fifteen years old survives him

As stated above the characteristics which have been the means of placing the name of Dr Lyman upon this renowned list are not the usual variety but are for the most part of a more or less personal nature His professional life is vividly illuminative of certain phases of the practice of medicine It illustrates so well the unheralded heroism so often associated with it it signifies so perfectly the quality of service the development of which the practice of medicine offers it shows so well wherein true *greatness* so often lies and demonstrates so conclusively that even in a field which is restricted in the commonly accepted sense of the term as was his the highest ideals in medicine may be reached and that opportunities if taken advantage of may serve to place one of our humble calling upon a pinnacle second to none

To recite a history of the professional life of Dr Lyman is but to recount an ensemble of activities which can best be encompassed by the term *service* Success and misfortunes were intimately blended with his career to an unusual degree He accepted the former with unwonted modesty the latter with admirable fortitude

He was a giant in stature and endowed with an extraordinary capacity for both physical and mental action His splendid physique his handsome benevolent face which was so evidently an index to the many fine qualities with which he was gifted—sincerity honesty sympathy broad intelligence and sound judgment—engendered confidence in all who knew him These attributes at once brought him a large clientele the care of which taxed his strength unusual though it was to the utmost through his professional life He could not refuse a summons from a patient Regardless of the distance or the hour Doctor John always responded In the early days many patients were attended and operated upon in their homes many miles from Eau Claire Even in the later years Dr Lyman covered a large territory generally by automobile caring for those families who through all the years had depended upon him for succor

Many years ago he developed a duodenal ulcer which by causing him great distress and a number of hemorrhages rendered the performance of his duties more difficult Upon three different occasions he was forced to relinquish his practice for protracted periods and upon each occasion the esteem in which he was held was evidenced by an even larger volume of work presenting when he pluckily returned to the harness

Only one factor was allowed to interfere with the constant care Dr Lyman lavished upon his patients. This was his most assiduous attendance at the various medical meetings throughout this country and even abroad. As an example of his practice along this line the writer who as a boy had known Dr Lyman need only relate that while the latter was a student at Rush Medical College Dr Lyman could be seen in the front row at the clinic of Dr Nicholas Senn each Thursday afternoon. This was over twenty five years ago. How often does one see such an example followed by surgeons of the present epoch in an effort to keep abreast of the times? Small wonder that he became an outstanding figure in his section of the country and that not only the laity but the profession as well looked to him for guidance.

The laity and the medical profession of Wisconsin felt his influence to a marked degree. His labors in improving the condition of the local hospitals and in rallying the public to their support are recognized by everyone in the section in which he practiced. All medical organizations received his hearty support and his sound judgment and kindly yet forceful demeanor when in the chief office or on important committees were often the means whereby a harmonious rather than chaotic, a strong and vigorous rather than a weak and vacillating organization went upon its way.

He had been president of the local societies including the County and State and was at the time of his death president of the Interstate Post Graduate Assembly. As a member of the Board of Governors of this organization and its predecessor—the Tri State—his counsels unquestionably had much to do with its ultimate success as he gave his time, experience and energy without stint to its upbuilding. The disheartening fact that his final illness prevented him from acting in the capacity of presiding officer of this organization which he had served so long efficiently and faithfully was a source of sorrow to all of its members.

About one year before Dr Lyman's death he sustained a fracture of the femur while driving his automobile to attend a meeting of the officers of the Interstate Post Graduate Assembly. After a prolonged convalescence he sustained a refracture. Long confinement and secondary anemia from recurrent hæmorrhages from his ulcer undermined his health to such an extent that he entered a Wisconsin hospital and after undergoing a severe stomach operation from which he recovered he developed broncho pneumonia which caused his death at the age of sixty nine.

The universal esteem in which he was held, the imprint of his acts of benevolence, his scientific achievements, the fact that he had during his forty five year of practice acted in the capacity of family physician and in later years family surgeon (a obriquet which was not infrequently employed in describing him), his unique standing with the laity which made it possible for him to mold public

sentiment in favor of things medical and the splendid example he set by invariably meeting adversity without complaint make mere words seem futile in an attempt to elucidate the manner in which Doctor John so completely fulfilled his destiny Few of those who have gone before have measured up better than he His life's work is a splendid example for everyone and there are few who have been so fortunate as to have so profoundly and beneficially influenced those with whom they came in contact as Dr John Van Reed Lyman The medical profession might well be proud could it number among its members more men of his type

ROBERT EMMETT FARR

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN MD FACS OMAHA NEBRASKA

THE AD ALMANSOREM OF RHazes

THOUGHTLESS utilitarianism commits crimes against art and culture which can be classified only as atrocities. And yet these crimes lend zest to the quest of the collector for even though the object when found may be imperfect and mutilated yet the thrill of discovery blots out for the time the memory of the atrocity committed in the distant past. The pages of manuscript illustrated here are an example of one of these literary crimes.

For centuries they served the purpose of covering a book printed and bound in the sixteenth century. Four centuries later the book was taken apart for rebinding by my friend Mr J Christian Bay. On the reverse of the vellum covering the writing was found and the pages were sent to me for identification and placement in their proper niche if such was possible. Fortunately the task was not an extremely difficult one else my powers would not have availed. The manuscript is in great part legible and written in passably easy Latin and by a lucky chance the page headed by the beautifully illuminated letter 's' proved to be the first page of a book and I read.

The words of Abubetri Razis son of Zacharie. The Book begins which by him was called Al mansor. Then followed another search and a year or so later after much reading of catalogue there arrived a book whose colophon reads. This work is ended printed at Venice by Jacobus Pencius de Leucho in the year of our Lord 1508 on the 8th day of March and the first book in the volume is the Latin translation of *Libe Razis ad almansorem* (The Book of Rhazes to the Caliph Almansor) which contains a compendium of the medicine and surgery of the Arabian Galen of the ninth and tenth centuries. The identification is now complete for save for a word or phrase here and there the manuscript and corresponding parts of the printed book are the same. The first page of the book is represented by the leaf with the illuminated letters and the other leaf contains part of the ninth and tenth pages of the printed volume.

The translation is that of Gerhardus of Cremona who was born in 1114 and devoted a long life of seventy three years to the translation of the Arabian medical texts into Latin among others this work of Rhaze. The handwriting of the manuscript is that of the twelfth or thirteenth century and it was probably one of the copies made for use by the physicians of the day. But what of the other pages? Can

we not imagine a printer and binder of the sixteenth century and one none too good for the book was of no special import tearing apart this beautiful folio volume in order to make covers for his mediocre books and thus scattering to the four winds a priceless fragment of world history? But it has always been so. The mind's eye sees a New England Puritan of the second or third generation with a large can of white paint and a whitewash brush smearing the beautiful mahogany surface of a Sheraton table so it will look nice and white and so fit into a spotless and shining kitchen blissfully unconscious the while that with each stroke of his brush he commits a crime compared to which grand larceny is a mere peccadillo. In this case a later furniture finisher will carefully scrape away the paint and bring back the lustrous sheen to the surface of the old mahogany but to our leaves of vellum time and the bookworm have wrought havoc that no restoration can remove and they must remain as they are to the end of time imperfect fragments of what was once a noble book.

The author of this book Rhazes became the foremost of the physicians of the early Arabian School. Until he was thirty years of age he was known only as a famous bard and player on the cithara though he had obtained a good education in philosophy. Then he decided to study medicine and went to the University of Baghdad which had been founded in the early part of the eighth century and was eclipsing the school at Jondisapur. He left the University to return to his birthplace the city of Rai and undertook the task of organizing its hospitals. Once more he returned to Baghdad this time as the director of its great hospital and apparently as head of the medical department for he is believed to have drawn many students to Baghdad because of his great ability as a teacher.

During his long life—he probably lived to be over eighty—he traveled much. He visited Jerusalem Egypt Syria Persia and went as far as Spain where he studied the medicine of the Western Caliphate but in spite of his great vogue as physician and surgeon he died in blindness and poverty.

In the main his work follows that of the Byzantine physicians principally Paul of Aegina. He did some operative surgery following this master. He is known largely for his short and pithy sayings one of which is. Truth and certainty in medicine is a aim which is not to be attained and the healing art as is described in books is far inferior to the practical experience of a skillful and thoughtful physician.

REVIEWS OF NEW BOOKS

GERMAN publishers are putting forth at the present time numerous books on cancer. Two of the latest of these are *Mutationstheorie der Geschwulst Entstehung*¹ by Dr. Med. K. H. Bauer and *Ueber das Problem der Boesartigen Geschwulste*² by Professor Dr. Lothar Heidenhain.

Professor Bauer's book is a small brochure of 7 pages and the thesis may be stated briefly as follows: Just as new species may result from mutations due to some permanent and transmissible alteration in the genes of the germ cells, so tumors may result from mutations due to permanent and transmissible alterations in the genes of somatic cells. Professor Bauer first presents a brief statement of the theory of mutations and then discusses the occurrence of mutations in germ cells and somatic cells. As examples of the latter he cites localized albinism (leucoderma), solitary exostoses, etc., which he believes are due to sudden alterations in the genes of one or more cells in a localized part of the body. These continue to reproduce cells with similar altered characteristics. Local alterations in genes and any resulting local changes in cells have certain definite characteristics: they occur singly, they are neither inherited nor inheritable, and they are morphologically identical with corresponding general forms.

This general idea is then applied to the origin of tumors in which the alteration in the genes is permanent and irreversible. Bauer insists that the division of tumors into benign and malignant growths is not scientific or practical and is not based on pathologic-anatomical or on clinical grounds. He applies the mutation theory to the etiology of tumors. Exogenous factors such as non-specific irritants induce tumors only when they cause cell mutations that is when they alter the genes or the chromosomes. Endogenous factors (which are not mentioned specifically) affect the cells of an organ or system in such a manner as to render them more susceptible to external irritants. Bauer insists that there is no cancer heredity in the scientific sense that is no transfer of the disease itself by way of a mendelian gene. It is a matter rather of inheritance of tissue inferiority which actively favors the origin of tumors in the presence of added exogenous factors.

Professor Bauer's brochure is a closely reasoned thesis based largely upon theoretical considerations. He quotes Schwarz to the effect that the gene is a hypothetical assumption and Bauer's whole thesis is founded upon the alleged presence of genes in somatic cells and the transmissible alterations which may take place in them. Much of his reasoning is

from analogy—always a dangerous method—such as alleged similarities between genes and atoms and electrons. The work is therefore not wholly convincing but it does suggest a line of investigation into the origin of tumors which might be followed by expert geneticists possessing a greater knowledge of the fundamental problems involved than a professor of surgery could be expected to possess.

Professor Heidenhain also a surgeon has produced a more pretentious book of 153 pages measuring 13 by 20 inches and containing 141 illustrations chiefly photomicrographs.

These two volumes present many sharp contrasts. Bauer develops his conception of the etiology of tumors on the basis of the mutation theory of heredity. Heidenhain on the other hand is convinced of the infectious nature of the cause of tumors. He insists that the origin of malignant neoplasms is not purely a problem of cell growth. His starting point appears to have been the experiments of Kevsner who injected 100 mice with material from 4 malignant human tumors and after intervals from 7 to 13 months found tumors in 4. However 4 per cent is not a very high incidence of tumors in mice unless one is quite certain of the background of heredity in the stock of mice used.

Heidenhain developed the working hypothesis that means can be found for so destroying human cancer cells by lysis that the supposed cancer-causing agent will not be destroyed. This product of lysis of cancer cells when injected into animals is to be expected to produce tumors. According to the place in the body where the cancer-causing agent acts epithelial or connective tissue tumors, carcinomas or sarcomata will originate thus furnishing an etiological unity. Heidenhain prepared autolysates of various malignant tumors and injected these into mice and claims to have induced tumors in 5.2 per cent of the animals. He found no difference in the effects of the autolysate of aseptic and infected tumors and concludes that bacterial infection is not concerned in the causation of tumors alleged to result from inoculation.

The entire book is a profusely illustrated presentation of evidence which is presumed to favor the acceptability of the author's working hypothesis but the labored discussion is far from convincing. Heidenhain reports positive results (tumors) in 83 (5.2 per cent) of 1601 injected mice, some of which had multiple tumors. He cites statistics from Miss Slye's publications to the effect that she found spontaneous tumors in 1.25 per cent of her tumor strains of mice. Because neoplasms occur spontaneously with relatively great frequency in mice these are not satisfactory animals on which to base any claim as to the infectious nature of tumors. Heidenhain attempted to exclude cancerous heredity in his mice by the testimony of the breeder from

MUT. THEOR. G. GESCHWULST. ENTSTEHUNG U.
Dr. M. K. H. B. B. J. I. Sp. S. G. A. E. D. C. B. Y.
U. R. S. P. M. D. B. O. E. S. G. K. G. W. E. L. S. P.
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D. Loth. H. d. ab. in. B. J. n. J. li. Sp. g. S.

of pregnancy and labor and then the pathology of all these is given in detail. Two sizes of type have been used the larger size indicating the fundamental and more important matter and the smaller size the details of physiology pathology and of the various methods of treatment. The student thus has a textbook and a reference book in one volume.

It is noticeable that references to the literature are up to the minute in fact some of the books referred to were published only a few months before the appearance of this edition.

The chapters on the treatment of hyperemesis eclampsia abruptio placentae placenta praevia rupture of the uterus postpartum hemorrhage breech presentation and the operation of forceps have been almost completely rewritten and the entire work has been greatly improved.

The author recommends low cervical caesarean section instead of the classic section in all but exceptional cases. In the treatment of the lateral and central placenta praevia cases he favors caesarean section in most primipara when vaginal delivery promises to be tedious and difficult.

The chapters dealing with puerperal infection are particularly well written and an excellent detailed discussion of the treatment of these cases is given. In the treatment of threatened abortion the use of castor oil is recommended. The reviewer cannot agree to this.

After a thorough reading of this work the reviewer feels that this volume is one of the best textbooks on obstetrics on the American market.

EDWARD L. CORNELL

In the preface to *Clinical Medicine* Bethua states that his purpose in writing this book has been to put into one volume of moderate size the latest and most generally accepted information as to the diagnosis and treatment of about one hundred of the

Ce L M By O W B ch M D Ph G T C
F A C P Ph D l ph d L d W B S J C m p y g s

most common diseases coming within the province of internal medicine. This has been done in order to meet the needs of the large group of practitioners who must carry on their work without the opportunities afforded by modern hospitals. The book is based on the lectures given by Bethua to under graduate and postgraduate students during recent years at Tulane University.

The plan proposed has been faithfully followed and the author is to be congratulated upon having executed a work which is rich in practical information of a sort that is certain to be useful at the bedside. Much well deserved commendation may be given to this book. The clinical descriptions are concise and complete. The therapeutic sections are excellent and many practitioners whether or not they belong to the groups to whom this work is especially directed will find the discussions of treatment most useful.

Throughout the volume the endeavor for brevity has occasionally resulted in a terseness of expression which is almost harsh but this rarely applies to the therapeutic sections. Again it appears that the same emphasis upon short direct concise descriptions has led to occasional paragraphs of ambiguous meaning. For instance the short section on auricular fibrillation leaves the impression that normal rhythm is frequently the result of digitalis medication and that quinidin is essentially interchangeable with digitalis in the treatment of this condition. Another edition might well include brief descriptions of the essential pathology of the various diseases for this is after all the groundwork of diagnosis and treatment and one regrets the almost total omission of the pathological conditions underlying disease.

Though minor criticisms may be offered this book ought to be a source of real help to many physicians who want to refresh their minds quickly concerning the important facts of diagnosis and treatment.

JAMES G. CARR

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selection will be made for review in the interests of our readers and as space permits.

THE CAUSES OF ANTE NATAL NATAL AND NEO NATAL MORTALITY OF INFANTS WITH SPECIAL REFERENCE TO SOUTH INDIA. Being the Elizabeth Mathai Lectures Delivered Under the Auspices of the University of Madras at the Gifford School of Obstetrics. By A. Lakshmanaswami Mudaliar. B.A. M.D. Madras Associated Printers 1938.

HYDATID CYSTS OF THE LUNG IN CHILDREN. By Marcelino Herrera Vegas. M.D. F.A.C.S. F.R.S.M. Buenos Aires. S.A. Imprenta Lamb y Cia. 1938.

EUROPEAN CLINICS. Editorial Staff of European Clinics 1927. Dr. William Lintz. Edit. in Chief. Philadelphia and London. J.B. Lippincott Company. 1938.

CUMULATIVE SUPPLEMENT AND COMPOSITE INDEX. Gynecological and Obstetrical Monographs. New York and London. D. Appleton and Company. 1928.

DIE TECHNIK DER EINGRIFFE IM GALLENSYSTEM NACH DEN ERFAHRUNGEN DER KLINIK ILSBERG UND DER CHIRURG ABT. DES WILHELMINEN SPITALS. By Dr. Peter Walzel. Mit einem topographisch anatomischen Teil by Dr. Oskar Schumacher. Vienna. Julius Springer. 1938.

ROENTGENOLOGY ITS EARLY HISTORY SOME BASIC PHYSICAL PRINCIPLES AND THE PROTECTIVE MEASURES. By G.W.C. Kaye. O.B.E. M.A. D.Sc. New York. Paul B. Hoeber Inc. 1928.

CONSECRATION MEDICI AND OTHER PAPERS By H rvey
Cu hing MD B ston L ttle B own nd C mpa y
1928

POENTGENOLOGY THE BORDERLAND OF THE NORMAL
AND EARLY PATHOLOGICAL IN THE SALIAGRAM By Alb n
koehl Fifth Germ n ed t n tra sl ted by Arthur
T mb ll MA BSc MB ChB (Glas) N w y o k
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STERILITY IN WOMEN DIAGNOSIS AND TREATMENT By
Sid y Fo sck MD BS (Lond) FRCS (E nd
Ed n) N w y k William W d d C mpany 928

ANNUAL REPORT OF THE SURGEON GENERAL OF THE
PUBLIC HEALTH SERVICE OF THE UNITED STATES FOR THE
FISCAL YEAR 1918 Wa hin t n D C United Stat
Go ernm nt P t g Office 98

MONOCLINIC MONOGRAPHS THROMBO VAGHITI OBLI
ERANS CLINIC L PHYSIOLOGIC AND PATHOLOGIC STUDIES
By Georg E B wn and Edga V Allen Collab atn g
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METHODS AND PROBLEMS OF MEDICAL EDUCATION
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DIABETIC SURGERY By Lel d s McKinnick MD
FRCS dHow d Root MD With F ew d by
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d lphia I & G b 98

DIAGNOSIS ET THÉRAPEUTIQUE PAR LE LIPIODOL
CLINIQUE ET RADIOLOGIE By J A S a d a d J Fo st
Pa Mass n et C 98

LA TACTIQUE OPÉRATOIRE P b l h d u d th dr
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de V B la i By W M St n and R Fo ch
Pa Gast n Do t C 99

LA PRATIQUE CHIRURGICALE ILLUSTRÉE Edt d by
V t Pa ch t V l P G t D t Ce 99

PRACTICE OF SURGERY CLINICAL DIAGNOSTIC OBLI
ATIVE AND POSTOPERATIVE Edt d by Dean L w MD
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VERDAUUNGSKANALS d fully ed by D H Ch ul
With a fo w d by Fe dina d S ue hruch B lin J l i s
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OLD MASTERPIECES IN SURGERY BELG A COLLECTION
OF THOUGHTS AND OBSERVATIONS E GENDERED BY A
PERUSAL OF SOME OF THE WORKS OF OUR FOREFATHERS IN
SURGERY By Alfred B wn MD Privately Printed
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INTERNATIONAL CLINICS A QUARTERLY OF ILLUSTRATED
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Edt d by Harry W Catt ll A M MD with th ll b
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HYDATID DISEASE ITS PATHOLOGY DIAGNOSIS AND
TREATMENT By H ld R D w MB BS FRCS
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LEUCOPLASIE ET KRAUROSIS ULLAIRES ETUDE ANO
MO PATHOLOGIQUE TRAIT MENT CHIRURGICAL B C
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A TEXT BOOK OF SURGICAL DIAGNOSIS Ed ted by J
W lton MB FRCS BSc MB A ls i a du v
Y k W l m Wood & C mpy ny 1928

TREATMENT OF VENEREAL DISEASE IN GENERAL P ac
ce By E T Burk DSO MB ChB (Glas)
York a d Lo don Oxford Uni ty Pr 197

A HANDBOOK FOR THE DIABETIC By Alb t H R
BS MS MD N w y k a d Lo d n Oxford Uni
sty Pre 108

QUALITATIVE AND VOLUMETRIC ANALYSIS FOR ME C t
STUDIES By H Lamb m MA MS FIC t
J A M tch ll MS N w y k a d London Oxford
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CHILD HEALTH AND CHARACTER By Ell b th M
Sl n Ch sser MD New Y rk a d Londo f d
U r ty Pr 197

METHODS OF BIOLOGICAL ASSAY By J H B m MA
MD (Camb) W th an I t d c to an H H B l
CBE S KS MD FRCP N w y k d Lond
Oxf d Un ty P 98

LIPIODOL IN THE D GNO IS OF THORACIC DISEASE By
F G Ch ndle MA MD (Cantab) FRCP (Lo d)
N w York d Lo d n Oxf d University P s 98

TUMORS ARISING FROM THE BLOOD VESSELS OF THE
BRAIN ANGIOMATOUS MALFORMATIONS AND HEMO
BLASTOMAS By Ha ey C hum and Perci l Bailey
Sprin f ld Hlin s Ch l s C Thomas 928

LEZIONI DI OSTETRICIA E DI CLINICA OSTETRICA By
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danz P rto Puerper V l —Operazioni Ott h
Mila o Soc An I stituto Edit le S ntib o 928

CHIRURGIE DES VOIES BILIAIRES SPÉCIO CHIRURGIC
TOMIE By C S bré C sas Préf e by P J L Fa r
Pa is Masson et C e 98

ANNALS OF ROENTGENOLOGY Edited by Jam T C
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d ed By H rman A O od MD d ed re New
Yo k P l B H ebe I 99

DIE CHIRURGIE D BRUSTO CANC By Fe din nd
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AMERICAN COLLEGE OF SURGEONS

SOME THOUGHTS ON THE NATURE OF CANCER¹

SIR CHARLES BALLANCE KCMG CB MVO LONDON ENGLAND

THE International Conference on Cancer which was held last July in London evoked great interest. Scientists of all nations joined in the 'great consult'. They thought nothing hard much less to be despaired. The goal of effort was the discovery of the intimate nature of the disease and of the means for the prevention and cure of its lethal incidence on the human race.

When Homer told the story of Troy, he did not write prose or even history; he everywhere infused into it an incomparable ardor—he made an epic. An epic is a theme of action treated in heroic proportions and style. In our profession the life enthusiasms and moral qualities of such men as Pasteur and Lister present to our minds epics of incomparable ardor. Their struggles were great, the issues were great, the men were great. It appears to me that the hopeful side of our labors is that some of our colleagues are approaching the subject of the cause of cancer in the epic spirit.

The most important events of history are to the novelist what gigantic mountains are to the traveler. He surveys them; he skirts their base; he salutes them as he passes; but he does not climb them. In the same way I propose to survey, skirt and salute some of the great landmarks in the research into the nature of cancer.

The chief papers and debates at the London Congress dealt with the early diagnosis and the relative value of surgery and radiation in the treatment of carcinoma of the stomach, mamma, uterus, mouth and rectum and of sarcoma of bone. There was also a short statement by Dr Lumsden, concerning tumor immunity and vaccine treatment, but the debate which interested me most was that on the etiology of cancer.

The use of lead as a remedy did not obtain general acceptance. I do not object to a remedy because it is toxic. No remedy is a practical remedy when the margin of safety between its lethal effects and its beneficial influence on the growth is less than that which admitted of reasonable control by the family doctor.

There was a general feeling that the rule persists that operation is essential in the treatment of cancer, but that operation combined with radium was in certain cases e.g., carcinoma of the mamma of increasing value. For sarcoma of bone in which amputation does but delay the fatal issue, some hopeful results were reported following the use of radium and toxins or radium alone. The biological effects of radium and X-rays were discussed by experts.

When I was a house surgeon, it was generally thought that an attack of erysipelas after an operation for carcinoma mammae had some effect in preventing the recurrence of the disease. I was in Berlin in 1884. Fehleisen was assistant to von Bergmann and he was infecting cases of carcinoma mammae with the organism of erysipelas. The students nicknamed Fehleisen 'erysipelas coccus'. When the attack of erysipelas was severe the tumor might slough out. A death occurred and the treatment was stopped. Fehleisen was a forerunner of Dr William B. Coley. This gives me the opportunity of paying a humble tribute to the transparent honesty and diligence of my friend Coley during a long period of years in his attack on the problem of cancer treatment. I have no doubt myself of the beneficial influence of the toxins in certain cases of cancer. The quality of honesty and straightforwardness is esteemed in my country and yours as a thing beyond price and of higher value than all the riches of the Orient. We are pilgrims of surgery who have reached only to the threshold of truth. In that pilgrimage the name of Coley will ever hold an honored place.

Paracelsus held that Nature was sufficient for the cure of most diseases. Art had only to interfere when the internal physician was tired and incapable. Then some remedy had to be introduced which should be antagonistic not to the disease in a physical sense but to the spiritual seed of the disease. I look forward to the time when our terribly mutilating operations for the cure of cancer which must be performed at present will be replaced by a vaccine or some such

remedy which will be antagonistic to the spiritual seed of the disease

Dr Lumsden spoke of tumor immunity and vaccine treatment. He said that antibodies could be produced which had a specific affinity for cancer cells; they attacked and killed the cancer cells without damaging normal tissue cells. After the use of vaccine the immunity was much higher than otherwise. He suggested that those who were treating tumors with radium should not be in a great hurry to get rid of the local growth by sloughing, because this would prevent the increase of immunity.

It has long been known that most tumors in the commonly used experimental animals regress after a time and that such animals are immune and cannot be further successfully grafted. Many years ago at the Buffalo Cancer Laboratory I saw mice who had in this manner become immune. This is not at all comparable to the regression of spontaneous tumors. Hence the same observation is rare in man. Many surgeons of much experience have observed the slow disappearance of a malignant tumor.

No one of us doubts the importance of the early diagnosis of malignant disease. But when a cancer gives a sign or a symptom it is not in the early stage of growth. I have no faith in what has been termed the pre-cancerous stage to me either a patient is suffering from malignant disease or he is not. I am all in favor of the intensive education of the family doctor concerning all newly discovered facts which may aid him in early diagnosis. But I am not in favor of lecturing to men and women of the lay public on a subject which they cannot in any measure understand and which is with them ever associated with fear and dread. Fear and dread depress the resistance of the body cells and like injury may be the partial cause of the disease.

The debate in London on the early diagnosis of cancer of the stomach and on the value of excision of simple ulcer of the stomach as a preventive measure was of much interest. I would only add this: none of us is possessed of a knowledge which can allow him to state this simple ulcer will become malignant. The prophet is a bad guide in surgery. Furthermore I am convinced of the immense value in selected cases of simple ulcer of the stomach of a posterior no loop gastro-enterostomy: the operation which we owe to your great surgeon William J. Mayo.

In 1884 I joined the first class in bacteriology ever formed in the ancient University of Leipzig. The teacher's name was Becker who was Koch's first assistant. The class was held daily for 6

weeks and was a great success. Becker insisted that Koch's four postulates must be fulfilled before any living organism could be held to be the cause of the disease. This is as true today as then.

My family had been decimated by malignant disease and as a student I had made up my mind when opportunity offered to work at its intimate pathology. When I returned to England I met the late Professor Shattock who was a microscopist and we started together on the great adventure.

Sir John Simon and Sir James Paget and other great pathologists of the mid Victorian era had noticed the vital difference in activity of the normal and cancerous epithelial cell. Speaking generally the cancerous epithelial cell is indistinguishable anatomically from the normal epithelial cell but its physiological life is different. The one has a normal life but some profound change has happened to the cancer cell. It has become endowed with an immortal life and the property of endless growth.

In those early days it was suggested that some outside spermatic influence caused the change in the epithelial cell which gave to it an immortal life. Whatever takes place in our bodies has two distinct factors: the intrinsic factor which is the constitutional or resisting power of the cells affected and the external injurious agent. The spermatozoon meeting the right ovule may create a life—a sort of other life or parabiosis.

I have always inclined to the belief that an external agent is the essential cause of carcinoma; that the infected epithelium is the habitat of the external agent and that it will live and grow in none other.

In the carrying out of research on the intimate nature of any disease it is essential to have an hypothesis of the nature of the disease in order to plan a scheme of work. The only scheme of work on the intimate nature of cancer which offers a prospect of success must be based on the hypothesis that some external agent is the essential cause. If it were possible which it is not it would be well if all our experimental work on the intimate nature of cancer could be carried out on carcinomata since certain types of round cell sarcoma are not easy to distinguish microscopically from granulomata while the microscopical appearances of the carcinomata are so definite that no mistake is likely to occur.

It is quite possible and indeed probable that the same external agent is the cause of both sarcoma and carcinoma. In the one case it finds a habitat in the mesoblastic cell and in the other in the epiblastic or hypoblastic cell. Sir James Paget long ago pointed out that the same insect

produces different kinds of galls according to the different sites of oviposition.

The view that sarcoma and carcinoma have a common origin receives support from the title of a case reported in 1926 in the *Annales d'Anatomie pathologique* by Lécroix and Lécroixque.

In 1923 a woman was operated on for advanced carcinoma mammae. Two weeks afterward a student of medicine aged twenty one was told to remove by a syringe fluid collected under the scar. In doing so a sudden movement of the patient caused the needle to be driven deeply into the palm of the hand of the student and a small amount of the fluid in the syringe also entered the palm. Two years later there was a hard swelling with pain in the palm of the hand and glands in the axilla were enlarged. A little later several small tumors appeared in the forearm and arm and amputation of the limb was performed. The beautiful illustrations accompanying the paper show clearly that the mammary tumor was a spheroidal celled carcinoma while the tumors which grew in the student's hand and arm were spindle celled sarcoma.

COMPARISON WITH TUBERCULOSIS

When I was a student anthrax was taken as the standard of comparison in pathological mycology. Let us take tuberculosis as the standard of comparison in the study of malignant disease. The late Dr. Bristowe compared cancer with other infective diseases and stated that in his view every general specific disease begins as a local process. This is true of both tuberculosis and cancer. The clinical history of sarcoma or carcinoma is so closely akin to that of tuberculosis that it is quite within the truth to assert that there is no feature in the last named disease which is not paralleled in the others. Before 1881 the authorities regarded tuberculosis as a disease with many causes. Today some authorities regard cancer as a disease of many causes and the specific organism remains undiscovered. But the analogy between tuberculosis and cancer is perfect and repudiation of the analogy leads only to despondency and despair.

The endemic location of cancer comprehending sarcoma and carcinoma about which much might be said is a highly remarkable fact in the history of malignant tumors.

The phenomenon of atavism has been observed both in tuberculosis and cancer. Parents seemingly healthy may beget a family of children who all die of phthisis. The taint is latent *in transitu*. It is within my knowledge that while the first and third generations of a particular family were devastated by cancer the second wholly escaped. Paget wrote: "The tendency

which exists in the parents may never become in him or her effective although it may become effective in the offspring. These events appear to result from temporary impoverishment of the peculiar soil or the atavism might depend not on the subject but on the parasite itself the life of which might present an instance of alteration of generations. The phenomenon indeed may be comparable to that which necessitates in agriculture a rotation of crops."

In carcinoma the primary tumor is seated most frequently at sites where an infection from without would most readily take place. The metastasis by lymphatics or blood vessels in carcinoma or sarcoma is such as occurs in tuberculosis. It may be restricted to the lymph glands or be as widespread as a generalized tuberculosis (general sarcomatosis or carcinomatosis).

Even the glandular infection which occurs at times in tuberculosis without primary lesion has its counterpart in the squamous cell carcinoma of the inguinal glands in chimney sweeps in whom there may be no discoverable primary growth. The latency of glandular infections is equally represented in tuberculosis and carcinoma. The sarcoma that grows at the end of a long bone after injury is comparable with the tuberculous osteitis existing under similar circumstances. Injury is the partial factor the other factor in the case of tuberculosis osteitis we know to be a specific virus. The relation of injury to tumor growth is illustrated by the case of a patient who fell striking the forehead against a sharp iron spike. The spike perforated the skull and brain. Death occurred 8 months later. The cause of death was angiosarcoma of the meninges and brain. The patient's brain would seem to have been inoculated at the time of injury with the virus of malignant disease as surely as a tube of culture medium is inoculated by plunging into it a platinum point deliberately charged with infective material.

Carcinoma has sometimes a purely local origin in the same way that a tuberculous infection may arise from direct inoculation. Take for example a case of squamous cell carcinoma of the lip. While still a local disease it may be completely eradicated. The case in fact is directly comparable to one of local tuberculosis from direct inoculation or to external anthrax which is still a local process and might be termed one of local carcinomatosis. Local irritation and injury are sometimes spoken of as causes of cancer. But this is not so. The efficient cause lies beyond the irritation or injury which are but the partial causes of the disease. The injury prepares a nutrient soil favorable for the growth of the tubercle bacil.

lus or the effective agent of malignant disease. Hereditary predisposition or diathesis is nothing more than the presence in the body of a suitable factor for the growth and development of the virus.

Many examples of auto inoculation have long been recognized, such as cœcal carcinoma associated with numerous lesser growths in the colon or an œsophageal carcinoma associated with several small growths below the primary tumor. These multiple small growths point to the possibility of an auto inoculation of the same kind as occurs in tuberculous ulceration of the intestine. Such facts prove that the cancerous epithelium has been transferred as a graft, but it does not prove the presence of a parasitic virus. It proves only that the cancerous epithelium cell or the agent which made it cancerous is infective.

When tubercles spread through the body from a primary lesion, all the secondary lesions are typical of the disease and contain the virus of it. The special anatomical characters of the secondary growths in carcinoma are ample proof of their source from the primary tumor. In sarcoma the best proof of the same fact is furnished by the melanotic variety where the pigmentation of the secondary tumors is sufficient evidence of their origin from the primary growth.

EXPERIMENTAL RESEARCH

After the rise of modern bacteriology, strenuous efforts were made to cultivate a specific microphyte from carcinoma. The results were uniformly negative. The failure of evidence in this direction led to the suggestion that the hypothetical microparasite might belong to the animal series, but the experiments in this direction were also negative.

How is the infection communicated to the epithelium if the carcinomatous parasite is a protozoon? How is the function of the first infected epithelial cell changed from a benign to a so-called malignant character? It may be in one or more of the following ways: (1) by absorption of a chemical product which is secreted by the parasite; (2) by the passage into the epithelial cell of the organism the latter maintaining a separate existence in the former; (3) by the process of rejuvenescence in which the flagging life of a protozoon is revived by means of union with another.

What happens to the epithelial cell first infected?

Although single binary division is the chief mode of reproduction, another method of multiplication is by the nipping off or budding of spores from the parent cell. It is also not uncommon for a protozoon to break up into from 10 to

100 or more pieces or spores. Each piece contains all the elements of a perfect cell. If the carcinomatous cell has a similar life history, the pieces or spores of the subdivided epithelial cell may each grow into an adult carcinomatous cell or may be thought of as conjugating with the surrounding normal epithelium, and of being the *fons et origo* in them of a carcinomatous rejuvenescence.

In sections of carcinoma there are certain appearances in the cells which were thought years ago to indicate the presence of a protozoon. I may cite the papers of Noeggerath, Soudakewitch, Foa, Ruffier, and Ludwig Pfeiffer. The opinion of Metchnikoff was that the appearances indicated nuclear degeneration. I do not know whether the virus of Gye belongs to the vegetable or animal kingdom, but if we suppose that it has its habitat in the nucleus of the cancer cell (and there are some reasons to think that this is so) that present the optical difficulties of demonstrating it seem insurmountable. It is possible that some of the previous microscopical researches on the nucleus of the cancer cell may not have been all fruitless. Indeed it may be asked why should the nuclei of the actively growing cells at the periphery of a malignant growth show signs of degeneration?

The failure to transplant human carcinoma to the lower animal might be due to the fact that it is necessary for the parasite to assume a phase outside the human host in order to transmit the disease. This side of the problem has not been perhaps sufficiently explored. As germane to this point, Prof. or Shattock and I carried out a series of experiments with the object of seeing whether experimental infection could be brought about from the psorospermial bodies so common in the rabbit's liver. We were led to do this after Darier's description of the presence of psorospermia in the epidermis in Paget's disease of the nipple, and the alleged association of psorospermia with carcinoma in general. The experiments were performed upon rabbits, monkeys, dogs, and rats. The chief experiments were performed on rabbits as being most likely to receive infection. Intravenous and other methods of introducing the psorosperms were employed, but in no case was the animal infected. If the positive results attained do not prove the existence of an external agent, it must be borne in mind that the negative does not disprove it. They show only that the methods employed to demonstrate it were not suitable.

The method of transmission in infective disease is not always so direct and simple as such graft experiments presuppose. It has been shown for example that malaria cannot be transmitted

between birds by the injection of blood containing the hæmatozoon

It has been shown that the capsule of an encapsulated protozoon consists at times of chitin or of cellulose. Both of these substances are absent from the tissues of vertebrates. Further pathogenic bacteria produce in cultures albumose. Neither chitin, cellulose or albumose can be demonstrated in a carcinomatous tumor.

Though it has not been possible to transfer human carcinoma to the lower animals it is well known that carcinoma can be transferred from animal to animal of the same species and even from man to man. One of the best and earliest examples of transference from animal to animal was recorded by Hanau who successfully engrafted squamous cell carcinoma from a rat into a series of other rats. In one experiment small portions of the tumor were placed in the abdominal cavity. Death ensued after three months and the abdominal cavity was found at the autopsy filled with nodules which presented the typical structure of squamous cell carcinoma. Dr Hanau showed me microscopical sections of the growth which was placed in the peritoneal cavity and also sections from the growing nodules taken after death from the peritoneal cavity. All the microscopical sections showed a squamous cell carcinoma of the same type.

Since Hanau's experiment numerous investigators have worked intensively on the intimate pathology of cancer and the discovery of the filterable viruses has opened out wider fields of research.

In 1913 Fibiger published a report of research on cancer of the stomach in rats. He was the first to cause experimentally a malignant growth. The ingestion of cockroaches infected with a special spiroplasma or the ingestion of the nematode larvae obtained from the muscles of the cockroach produced squamous cell carcinoma in the cul de sac of the stomach. The eggs of the parasite were found free between the epithelial cells of the cancer. The cockroach is the intermediate host.

In London at the conference debate on the etiology of the disease the main discussion centered on the work of Rous, Borrel, Murphy, Gye and Barnard and Leitch. Dr Murphy said that now after many experiments the real nature of the cancer agent seemed to be emerging. He said that it was possible to extract with a considerable degree of regularity from the normal testes of the fowl a substance which when injected into a normal fowl would produce a malignant new growth. Dr Murphy's belief is that the external agent is an enzyme, not a virus. Professor Leitch sup-

ported the view of Dr Murphy and stated that he had obtained a typical Rous sarcoma by the injection into a fowl of an extract of a normal fowl pancreas. The statements of Drs Murphy and Leitch did not carry complete conviction to my mind. I am by no means convinced that the experiments of Murphy and Leitch constitute a final settlement of the work of Gye. Whether the causative agent is a virus or Gye maintains or an enzyme as Murphy and Leitch hold its most remarkable quality is its specificity in action. This specificity enables it to produce invariably the same type of tumor as that from which the agent was obtained. What does emerge is that the best workers in this field of pathology are agreed that there is an external agent concerned in the production of cancer.

Sir William Bragg in his address last month to the British Association for the Advancement of Science reminded his audience that in the nineteenth century light was regarded as a series of waves in an all pervading ether. This theory was based on profound mathematical analysis and brilliant and far ranging observations. Sir William added that there is no question of its truth in the ordinary sense. But in the twentieth century a new field of optical research has been opened up and has led to the inference that light has many of the properties of a stream of minute particles. This theory has passed the experimental test and many experimental facts inexplicable on the wave theory are explained by the particulate theory. But how can anything be at once a wave and a particle? As yet there is no hint of reconciliation.

The dilemma is a rift in the whole fabric of scientific certainty. Is not the biologist in the study of the nature of cancer up against a dilemma which may be compared to that which now agitates the physicist? Virus or enzyme?—particle or wave? But there is hope of escape as *The Times* suggested for the scientific methods which have revealed it are still only scratching the face of the unknown.

When bacteria were first recognized as the cause of disease it was thought that their presence alone induced the disease. It was not till later that disease was discovered to be due to a specific chemical poison secreted by the bacteria. What is an enzyme? I do not know, but I do know that any active substance in the body for example a ferment is manufactured by a living cell. This truth brings the virus and enzyme theories into close relation. Spontaneous generation being excluded the crucial question is what of the cell which manufactures the enzyme of Murphy?

I am indebted to Dr. Andrewes for permission to refer to his work. He has repeatedly precipitated vaccine lymph and the final extract remains effective in the production of vaccina. Dr. Andrewes states that the process can be repeated indefinitely. The research will be published in this month's number of the *Journal of Pathology and Bacteriology*. No one can suppose that the globulin precipitates are re-globulin the cause of vaccina. It is clear that the virus has passed through all these stages of the purification of the original material without losing its specific character. In the same way I suggest that the frequent precipitations employed by Murphy in the case of the extract of fowl testes which he believes frees the resulting fluid from the virus of malignant disease fails to do so. The reasonable conclusion is that the precipitated neo-protein carries the virus with it.

The fact that in certain cases the virus of fowl sarcoma is to be found in the testes of this creature presents little difficulty to my mind. It is only an interesting observation for we know that the organisms of disease lie latent in our bodies. Otherwise it would not be possible to explain after injury to the testicle or to a joint the occurrence of tuberculous epididymitis or tuberculous arthritis.

The rare tumor chorionic carcinoma occurs in the uterus and occasionally in the fallopian tube and ovary. When the fallopian tube or ovary are affected it may be presumed that these organs have been the seat of early ectopic gestation. The tumor occurs at any age within the limits of possible pregnancy. It would seem that the permatozoön carried with it into the mature ovum not only its natural growth-producing power but also the external agent of carcinoma. It is possible that the spermatozoon is the host of this agent which is the essential cause of carcinoma. As germane to this view it may be remembered that chorio-epitheliomatous elements are found in certain testicular tumors.

When I entered the profession the members of the Pathological Society of London were engaged at their meetings in showing specimens of disease obtained from the postmortem room. But the times were changing. The work of Pasteur and Lister had begun to permeate the profession. Anæsthesia had been discovered. Gross disease could be examined *in vivo* and not only on the postmortem table. The great age of dead meat pathology was passing away and in its place a living pathology was arising the aim of which was the study and discovery of the intimate cause of disease.

I have already mentioned that as a working hypothesis in the search for the cause of cancer I pin my belief to an external cause. In all diseases in which the pathological anatomist has the authoritative voice intrinsic causes are sought after and extrinsic causes are relatively neglected. The idea of a specific extrinsic cause of any disease has owed its origin either to non-medical men like Pasteur or in later times to bacteriologists. Pathological anatomists have never embraced the idea enthusiastically. Indeed they have generally resisted any encroachment from this direction upon their special domain. I remember the opposition of the great Virchow to the opinion that tuberculous disease owes its origin to a specific microbe. In opposition in spite of his unrivalled authority—an authority no man could support now—was broken down because of the relatively simple and easily verifiable bacteriological findings of Koch. If the demonstration of the tubercle bacillus were entirely dependent upon animal experimentation of a complex character depending for interpretation upon acute insight into the pathological problem and upon scientific imagination in estimating probabilities I doubt whether to this day the opposition now proved to be reactionary of the morbid anatomist would have entirely disappeared.

The nature of cancer appears to be so mysterious a problem that perhaps we may say with Shakespeare of even the greatest mind in this field of experimental pathology that

Something sure
Hath puddled his clear spirit and in such cases
Men's natures wrangle with inferior things
Though great ones are their object

For in 1880 I attended a lecture by Sir John Burdon Sanderson. The subject was the nature of scrofula. He described how he had gathered dust from St. Paul's Cathedral from Westminster Abbey and from his own drawing room and how it had been placed under the skin of a series of guinea pigs. The result we were told was that all the guinea pigs were infected with scrofula and that the disease could not be a specific one as the specific agent could not be supposed to be in all the three places at the same time. I and my friends left the lecture theater feeling that the argument was not conclusive. The following year Koch demonstrated the tubercle bacillus.

In considering the problem of the cause of cancer I am not disposed to attach great weight to the opinions of those who merely study appear-

ances of dead tissues under the microscope I accept with due thanks their contribution toward the pathological definition of the fine structure of the cancer cell but I am not prepared to be governed by their theories. It is to animal experimentation that we must look for the solution of this mysterious problem. The pioneers of cancer investigation—Jensen in Denmark, Borrel in France and Loeb in America—confirmed the earlier studies of men like Hanau who had shown that animal cancer differs in no respect from human cancer and may be transmitted from animal to animal by the process of grafting. They showed however as the late Professor Shattock and I did that all the cancers studied gave no evidence of a cause separable from the cell. The cell appeared to be the indivisible unit of the disease. These observations confirmed by experimenters all over the world and especially on a large scale and with great exactitude by Ashford and Murray in London gave no encouragement to those who believed in an extrinsic cause of the disease. Some were overwhelmed by the apparent completeness of the proof or really by the absolutely negative character of all attempts to find an extrinsic cause. Even Borrel one of the earliest and most energetic pioneers and a believer in the microbic cause was nearly swept under by the wave of confident dogmatism which teaches that the disease cancer is a cell in which nuclear degeneration independent of microbic activity has occurred. Borrel was never able to accept this sweeping conclusion and endeavored to resist orthodox opinion. He stood almost alone for a long time neglected and powerless.

The tremendously strong dogmatic world opinion is still uppermost but not all powerful. Murmurs of discontent with the stagnant stage of cancer research have been heard in every country. In England the formation of the British Empire Cancer Campaign owes its origin largely to the existence of the feeling that new blood was required to study afresh the origins of cancer. Doubtless in America you have felt somewhat similarly. This murmuring of opposition to the authority of the pathological anatomist has found expression in attempts to get behind the problem of cancerous growth by instituting departments of biophysics, biochemistry and so forth. But it is not very likely that the true solution of the problem will come from oblique investigations. The study of cancer must be direct. But since the investigations of Cancer Institutes have proved so barren in their negativeness where shall we look for the lead in the great problem?

During the last three years there has been much discussion and more criticism of the researches of my countryman Gye. Now I should like to express my views on this matter. At once I must make it clear that I am not competent to discuss all the details of such work. I can give the reflections of one who has witnessed the fluctuations of medical opinion during fifty years and has seen that which was abused accepted and proved true.

Every discovery is a verified hypothesis and there is no discovery until verification has been gained up to that point it might be a guess which might have been erroneous. Hence the incalculable value of the method of experiment.

The wisdom of God receives small honor from those vulgar heads that rudely stare about and with a gross rusticity admire His Works. Those highly magnify Him whose judicious enquiry into His acts and deliberate research into His creatures return the duty of a devout and learned admiration.

I can look back to a period of research beyond that which embraces the lives of most of my hearers. I have heard Virchow, Helmholtz and Ludwig lecture. I have seen Pasteur and Lister and Paget at work. I was a distressed and angry witness of the opposition and abuse which assailed Pasteur and Lister in the early days of their immortal labors.

The first point in Gye's work is this that he sees the lead in cancer investigation to lie in the study of the remarkable group of fowl tumors which were first brought to light by Dr. Peyton Rous of the Rockefeller Institute. They are the exceptions in cancers in this that they give evidence of a cause and as has happened so often exceptions to general rules are likely to yield new knowledge which extends general laws. The work of Peyton Rous in proving the neoplastic nature of these fowl tumors has been properly acknowledged by Gye who has sought to understand the nature of the cause of these tumors and to link together the fowl and the mammalian tumors.

The essential claim which Gye makes is this that the clear cell free filtrate which is obtained by extracting a fowl tumor with saline and which contains the tumor's cause is not a simple single thing. The agent of the tumor is complex. Now the experiments which have been published in support of this contention have met with but little support. But if one takes into consideration the very very delicate nature of the tumor agent the fact for example that it disappears or becomes impotent after mere incubation at 37 degrees C. for a few hours and that it is demonstrable only with the highest power of the micro

cope and with the use of ultra violet light it is easy to understand that the difficulties of the work are very considerable. Gye believes that the evidence he has adduced is good enough at least as a first approximation to the truth to show that the virus found in the fowl tumors is common to many animal and human tumors.

I cannot form a definite opinion upon all these technical matters but I have been for 50 years intensely interested in and have done a little work on the problem. I would put forward this point for your consideration. It is not sufficient for anybody who is deeply concerned with the cancer problem to be merely destructive in criticism; it is the duty of critics to find some other explanation of the peculiarities of the cancer

problem if Gye's turns out to be wrong. At the present time it is the only explanation which fits together a series of apparently irreconcilable observations.

Truth is a golden thread seen here and there
In small bright specks upon the visible side
Of our strange being's partly colored web
How rich the converse! 'Tis a vein of ore
Emerging now and then on Earth's rude breast
But flowing full below. Like islands set
At distant intervals on Ocean's face
We see it on our course but in the depths
The mystic colonnade unbroken keeps
Its faithful way invisible but sure
*Oh! if it be so, wherefore do we men
Pass by so many marks so little heeding?*

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STRICTURES OF THE COMMON AND HEPATIC BILE DUCTS¹

POSTOPERATIVE PROGRESS IN SEVENTEEN CASES

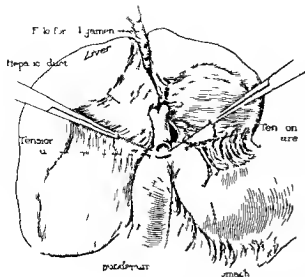
WALTMAN WAITERS M.D. F.A.C.S. ROCHESTER MINNESOTA

D. I. S. BY THE M. J. C.

CONTRACTURE and stricture of the common and hepatic bile ducts producing at first intermittent obstruction but later more complete obstruction of the common bile duct form an impressive group of cases. That most of such strictures are due to injuries to the ducts needs no further proof and reports that just as extensive contractures of the ducts have occurred spontaneously as a result of infection either in the biliary passages or their adjacent structures without the patient having been previously operated on can be found in the literature. The possibility of a spontaneous biliary stricture being carcinomatous is illustrated by Elting's case reported by Riggs in which 3 months after the excision of a stricture at the lower end of the common bile duct and choledochoduodenostomy jaundice again appeared. A mass in the region of the choledochoduodenostomy proved to be carcinomatous. Re-examination of the specimen of the stricture previously removed revealed after painstaking and careful search the presence of malignant cells. Rolleston believed that Andral's case of inflammatory stricture of the common bile duct reported in 1831 was probably carcinomatous. A perforated duodenal ulcer strangling the duct by the products of inflammation was reported in 1876 by Morgan who also stated that in 1860

Holmes presented before a pathological society in London a stricture supposed to be due to the passage of a stone from the common bile duct. If such did occur the possibility of the stone fretting away at the walls of the duct producing ulceration seems more likely to have been the cause rather than the passage of the stone. Bristowe reported a case of stricture of the intestinal portion of the common bile duct which he believed might have been syphilitic substantiating this by demonstrating extensive small round cell infiltration surrounding the bile ducts. Two cases of fibro adenoma in the stump of the cystic duct producing typical symptoms of common duct obstruction were reported by W. J. Mayo in 1916.

Prior to 1914 strictures of the common or hepatic ducts were reported for the most part as single cases. In this year Jacobson reported one case of his own and reviewed 34 others from the literature. He directed attention to the various methods used in the repair of the stricture as well as to the immediate postoperative result. Ellsworth Eliot Jr. in 1918 reported 3 cases of stricture of the hepatic and common bile ducts in which he operated. He also made an exhaustive review of the literature and grouped the cases according to the method of treating the stricture the results in each case were recorded.



11. Chl l h d d n t m v th n d t d t m

McArthur in 1923 and Douglas in 1916 reported several of their own cases. Judd in 1915 reported the results of operation in 48 cases of stricture of the common and hepatic ducts in which operation had been performed.

PATHOLOGIC ANATOMY

In an address on the Functions of the Biliary Tracts in Relation to Their Pathology, Wilkie stressed the necessity of studies of the normal structure and function of the parts concerned which require a knowledge of minute anatomy and physiology. During the last 3 years Burden and Counsellor and McIndoe have made interesting contributions to the knowledge of the structure, size and condition of the biliary tract in health and in disease. In a study of the pathological anatomy of the bile ducts Burden summarizes as follows:

The hepatic and common bile ducts are identical in structure. They are lined by a layer of tall columnar epithelium which covers a surface made up of numerous shallow depressions. The epithelium rests directly on a thick compact layer of elastic connective tissue which makes up most of the thickness of the wall and on which the telescoping of the duct is mainly dependent. The outer coat of the duct is composed of a layer of areolar tissue in which are found bundles of unstriped muscle, blood vessels and lymphatics.

The walls of the ducts are richly supplied with glands which are situated for the most part in the outer coat but the ducts of the glands coming together from all directions finally empty into ampullar-like openings which are arranged in a regular manner around the duct and communicate with its lumen. There is no evidence of true pancreatic sacculi or diverticula.

The ducts are provided with well developed musculature which is composed of isolated longitudinal and circular bundles situated in the outer layer of the duct and separated from each other by connective tissue. The muscle does not form a compact layer but is arranged as a loose network.

The most frequent pathologic changes in the duct are those of inflammation. Cholecystitis is nearly always accompanied by infection in the wall of the ducts. The lesions are those of the usual chronic inflammatory type characterized by lymphocytic infiltration and the production of fibrous tissue. The glands may retain infection and aid in its dissemination through the duct. The gland responds to the irritation by an overproduction of mucus and becomes dilated and cystic. The process of repair is attended by the formation of fibrous tissue which results in a thick and inelastic tube.

Judd and Counsellor studied the structure of the intrahepatic biliary tree by the collodion injection corrosion method combined with microscopic examination of the biliary tree itself and called attention to the fact that general obliterative cholangitis may exist months before signs of stricture. They noted that the strictures of the common bile duct differ from those following simple aseptic ligation in that the infective process was already resident in the ducts previous to the operation at which the injury was inflicted. Hence the retained bile is rapidly infected and exacerbation of acute cholangitis follows. Although moderate dilatation usually occurs it is rarely extensive and may be absent altogether.

It must be concluded that infection of the walls of the common and hepatic bile ducts is among other factors causative in the production of benign strictures of these ducts. Continuation of this infection with infection of the intrahepatic branches of the biliary tree in the proportion in which they exist when compared to the normal may determine the prognosis in each instance after operative restoration of continuity of the biliary tract. This I believe should be given careful consideration in studying results of the surgical treatment of

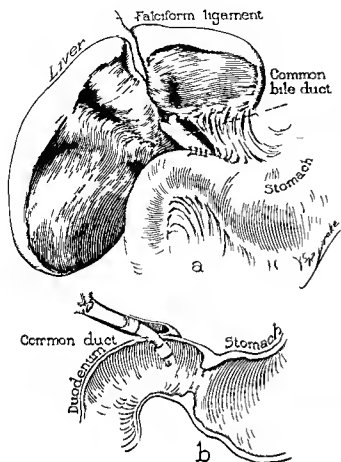


Fig. 1. Use of rubber tube in lateral choledochoduodenostomy. Case 3

strictures of the common and hepatic ducts remembering that if sufficient normal duct remains proximal to the stricture to permit accurate anastomosis to an incision in the duodenum excellent results can be expected but under different circumstance one must be content to secure improvement of health even though short periods of jaundice and possibly of fever occur at infrequent intervals. Excellent results are always to be sought for but it is not to be expected that they can be obtained in every case.

RESULTS OF OPERATION FOR STRICTURE

In a series of 83 cases in which I operated for obstructive lesions of the common and hepatic ducts and tumors in the head of the pancreas during the last 4 years there were 17 in which benign stricture of the common or hepatic duct was the cause of the biliary obstruction. Fourteen of these patients are living. Seven have had excellent results and have been free of pain, jaundice, chills and

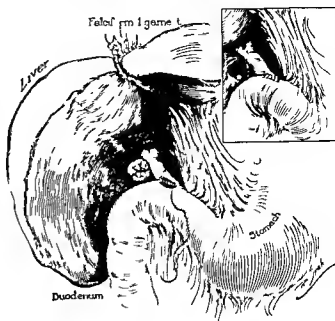
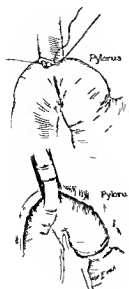


Fig. 3. Choledochoduodenostomy in a case in which operation was followed by temporary duodenal fistula. Case 1

fever or itching. The remaining seven have had fairly good results; they are working and free of constant jaundice, yet at intervals have a temporary incomplete biliary obstruction as evidenced by slight jaundice or chills and fever. Two patients died in the hospital following operation (Cases 12 and 17, tabulation). Both were deeply jaundiced at the time of operation and with serum bilirubins of 12.8 and 10 milligrams. One of these (Case 1) had a greatly enlarged liver and splenomegaly. At postmortem examination suppurative cholangitis, hydrohepatosis, and intra-abdominal hemorrhage were found. Of further interest is the fact that the biliary obstruction had existed for 11 months before the plastic reconstruction of the stricture. The other patient (Case 17) had lost a great deal of weight, weighed 80 pounds at the time of operation and had been deeply jaundiced for months with serum bilirubin of 10 milligrams. She had been operated on twice elsewhere for a perforated duodenal ulcer in April 1927 and again in November 1927 at which time the gall bladder was removed. Another patient, a woman aged 64 years, died after she had recovered from the operation. Hepatico-duodenostomy was performed at which time only a fringe of hepatic duct remained for anastomosis to the duodenum. She left the



I 4 U f b b } l d o h d d n t m y
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hospital 8 days after the operation in good condition free of jaundice but she died suddenly 6 months later cause unknown

METHODS OF RECONSTRUCTION

Jacobson Eliot and Judd summarized the various methods employed in the restoration of biliary continuity. In Judd's report in 1915 he stated that the method of hepaticoduodenostomy first developed by W. J. Mayo in 1905 had proved the most practical the most widely applicable and the most successful procedure for establishing the natural course of the flow of bile (Figs. 1, 2, 3 and 4).

I have used this type of procedure both in hepaticoduodenostomy and choledochoduodenostomy in 6 cases in 3 of which excellent results followed without further evidence of biliary obstruction. In the sixth case Case 3 in the tabulation severe intrahepatic cholangitis appeared months after complete relief of biliary obstruction by choledochoduodenostomy. Subsequently the liver which had been cirrhotic at the time of operation increased in size the spleen became palpable and ascites occurred. By the use of one of the mercurial diuretics the ascites was controlled. When last heard from the patient had been free of fever and jaundice for several months (Fig. 1).

In connection with the prolonged good results following choledochoduodenostomy or hepaticoduodenostomy it should be noted that in one of these cases (Case 1)¹ a duodenal fistula developed immediately after operation the toxemia of which was controlled by the method described by Walters and Bollman. The patient has been perfectly well for more than 5 years without the slightest evidence of obstruction or disease of the biliary tract (Fig. 3). This case has been reported in detail previously.

In another case (Case 2) choledochoduodenostomy was performed in August 1927. Accumulation of bile around the liver depressed the organ and produced a chain of events characterized by extremely rapid pulse increase in respirations and semi-consciousness this rapidly disappeared when the patient's wound was reopened in her room with the evacuation of the bile and the return of the liver and circulation to normal. A normal convalescence followed. The patient was allowed to return home 4 weeks after the operation the wound was healed and her general health was excellent. She has been free of all jaundice pain or fever since the operation and feels perfectly well (Fig. 4).

PLASTIC OPERATIONS ON THE COMMON BILE DUCT

Following the report of McArthur's successful cases of plastic operation on the common bile duct in 1925 in which a catheter was used to serve as a scaffold for healing and a means for transmitting bile three plastic operations on the common duct were attempted in cases which were not well suited to this procedure. Instead of excising the stricture and making an end to end anastomosis which the nature of the obstruction did not permit the stricture was split longitudinally allowing sufficient lumen of the duct and then a closure was made transversely. In these 3 cases the results of operation have been only fair. They have each presented at infrequent intervals evidence of what would seem to be incomplete biliary obstruction with occasional symptoms of transient jaundice or chills and fever with pain (Fig. 5).

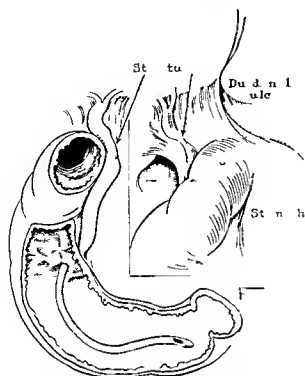


Fig. 5. Plastic operation for localized stricture of the common bile duct and excision of duodenal ulcer. Case 3.

In fairness to a discussion of plastic procedures on the duct itself it must be said that an attempt was not made to secure union between the normal portions of the duct beyond the stricture since the stricture was not excised but rather to increase the lumen of the duct to normal or more than normal. However, since performing these three plastic operations on the duct I have resorted entirely to the operation of hepaticoduodenostomy or choledochoduodenostomy when a sufficient amount of duct proximal to the stricture existed for anastomosis to the duodenum and the results have been excellent. On one occasion the stricture was confined to the upper portion of the common bile duct and involved the hepatic duct to such an extent that sufficient hepatic duct was not obtainable to anastomose to the duodenum. With plenty of normal common bile duct distal to the stricture a plastic procedure was carried out February 7, 1928, after the method of the Heineke Mikulicz pyloroplasty, a method which has been described as applicable to the common bile duct by both Moynihan and W. J. Mayo. An accurate anastomosis was made between the walls of the duct, rendering the size of

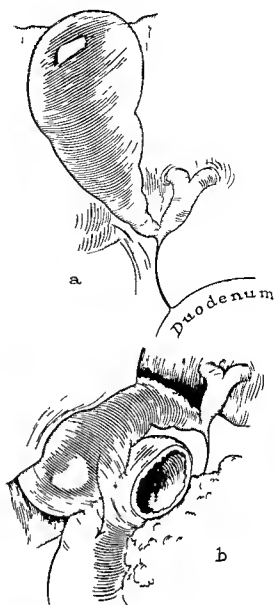
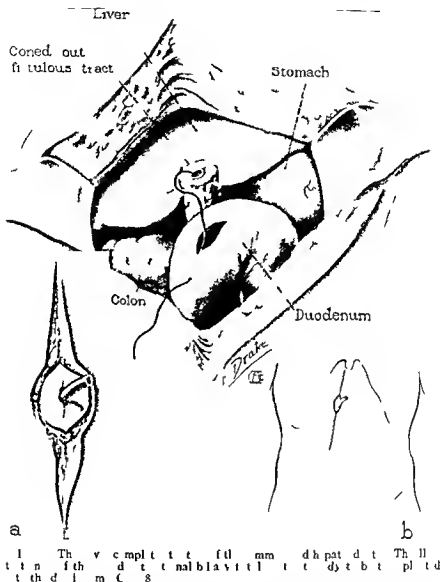


Fig. 6. Cholecystoduodenostomy for stricture of the lower end of the common duct. Case 13.

the lumen even larger than normal. The patient's convalescence was complicated by the development of a subphrenic abscess which was effectively drained (Harrington). Since operation there has not been any evidence of biliary obstruction. In the discussion of this case it should be said that the method of plastic operation on the duct was employed as a method of necessity and not one of choice. It seemed to afford the only way of restoring continuity in the extrahepatic biliary passages.

The simplest methods of restoration of biliary intestinal continuity are those in which the gall bladder remains and the stricture is



distal to the point of entrance of the cystic duct into the common bile duct. In these cases cholecystenterostomy is an easy solution of the problem. A woman aged 43 years who had been bedridden for almost a year subsequent to drainage of the gall bladder performed elsewhere has had a good result from cholecystoduodenostomy which I performed in January 1916 (Case 15, Fig. 6). She has been working and feeling well since her operation except for transient periods of mild jaundice with fever lasting a day. The periods appear at intervals of several months and probably indicate the existence of residual cholangitis which flares up at intervals. During

the last 9 months symptoms referable to the biliary tract have been absent.

TRANSPLANTATION OF AN ESTABLISHED EXTERNAL BILIARY FISTULA

Cases of stricture of the common and hepatic ducts in which an insufficient amount of normal common or hepatic duct remains below the level of the liver to permit anastomosis to the duodenum have constituted a surgical problem difficult to solve. The recent report, however, of successful transplantation of an established external biliary fistulous tract into the stomach or duodenum by Lahey, Masson, St. John, and Lilienthal has

served as an impetus to the use of this method in cases in which complete stricture of the extrahepatic biliary ducts exists. It should not be forgotten that the first successful transplantation of such a fistula was done by Williams at the Massachusetts General Hospital in Boston in 1914. The patient is still living and well. The ease with which such a coned out fistulous tract can be transplanted into the duodenum is surprising. The only precaution necessary is that the external fistula shall have been present long enough so that it can be coned out as a well established tract and that it is left attached to the liver.

In one case in which I operated establishing the external biliary fistulous tract in December 1927 and transplanting the coned out fistulous tract into the duodenum in March 1928 the patient has been free from pain, jaundice and fever, has gained in weight and feels well. The wound is solidly healed, stools are normal in color (Figs. 7 and 8, Case 8).

SUMMARY

It has been shown by various observers that inflammation of the intrahepatic and extrahepatic biliary passages is associated with strictures of the common bile duct and in many instances may be the predisposing factor to the development of the stricture. This factor too may account for the frequency with which incomplete intermittent obstruction occurs subsequent to plastic operations for the relief of strictures of the common or hepatic bile ducts in some cases.

A report of 17 cases of stricture of the common bile duct in which operation was performed during the last 4 years is presented with a description of the technique used as well as the progress in the months and years subsequent to operation. The operation of choledochoduodenostomy or hepaticoduodenostomy with an end to side or a side to side anastomosis with an accurate union of mucous membrane of the duct to that of the duodenum has proved to be the most satisfactory operation of the group. With this method excellent results have been obtained over a period of many months and in one case of more than 2 years.

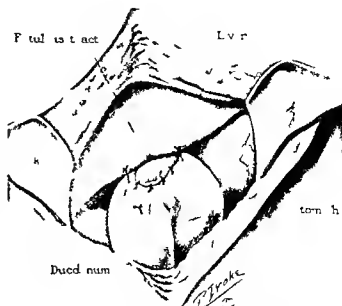


FIG. 5. Later stage in same operation as that shown in figure 4. Transplantation completed. Case 8.

The successful treatment of strictures of the common bile duct and the hepatic duct is dependent on the fact that sufficient duct remains proximal to the stricture to permit accurate anastomosis to an opening in the duodenum as well as that a minimal amount of infection exists in the walls of the duct and the intrahepatic biliary passages.

In one case in which there was a very large anastomotic opening between the duct and the duodenum severe cholangitis developed 2 or 3 months following the operation in the absence of extrahepatic biliary obstruction. It was accompanied by progressive enlargement of the liver and spleen and the formation of ascites. With the subsidence of the intrahepatic infection jaundice and fever disappeared but the enlargement of the liver and spleen still persisted. The ascites however disappeared after the administration of a mercurial diuretic.

A case is reported in which the establishment of an external biliary fistula for complete stricture of the common and hepatic ducts and the transplantation of the coned out fistulous tract into the duodenum was followed by a good recovery with relief of symptoms. The fistula was transplanted March 13, 1928 and the patient has been free of symptoms since. Six other successful cases of this type are reported in the literature.

SUMMARY OF RESULTS OF OPERATION—Continued

| | | | | C | CH | MY | | | | |
|---|---------|-------|------------------|---------------------------|---|--|--|-----|--|--|
| C | Ag d | D i f | S rum
bul bin | Sympt ms
d t | C d t f
g l l b l d d
t t m t | L d p t
p o c d | R l t f p t | | | |
| 6 | 49
F | 7 7 | 5 | J d t h g
d gas p
9 | Ch l c y t t m y g
(l w h) | St t f m m d
h p t d t St d
h p t d t Ch l d h
g t t m y T t b m
m d t | o- 7 g d l t t b p d 8-7
j d h l l d j p | 8-7 | | |
| 7 | 49
I | 7 5 8 | | J d g m d
t h g m th | Op t d d f p l
f t d d d y l
wh Ap l 9 7 (l
9 7 Ch l y t
t m y (f h) | Almost m p l t t t t
mm d h p t t d t
m w d h m g | D d h p t l h h g p t l t
t b d m l h e m h g | | | |

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MALIGNANT TUMORS OF THE FEMALE BREAST

A CLINICAL AND PATHOLOGICAL STUDY OF TWO HUNDRED AND THIRTY FOUR CASES
FROM THE CLINIC OF THE FREE HOSPITAL FOR WOMEN

GEORGE VAN S. SMITH M.D. AND MARSHALL K. BARTLETT M.D. BOSTON

THE material for this report was obtained by a clinical pathological study of 34 cases of malignant breast tumors 197 of which were treated at the Free Hospital for Women Brookline Massachusetts between 1873 and 1908 and 37 of which were treated in the private practice of William P. Graves and Frank A. Pemberton between 1909 and 1908. Seven cases 9 per cent were diagnosed sarcomata the rest were carcinomata. The diagnosis was made or confirmed by microscopic examination in all but 5 cases and these were clinically unmistakable.

AGES

The patients were classified into five year age group. Five were under 30 years of age the youngest being 22 and 8 were over 45 the oldest being 83. Between these two extremes the total number of cases in each age group reached a maximum in the 45 to 50 year old group. Nearly three fifths of the patients of this series were between the ages of 45 and 65.

FAMILY HISTORY

Of the 197 free clinic patients 7 gave a family history of tuberculosis and 33 (16.7 per cent) gave a family history of malignant disease.

PAST HISTORY

Fifteen patients gave a past history of breast trauma. In most of these it seemed evident that the trauma had served to draw the patient's attention to the lump. Four patients had had abscesses of the same breast and later carcinomata. In these patients the breast had been lanced respectively 7, 10, 10 and 15 years previously. In one the cancer had clearly originated in the abscess scar. In three instances a tumor had been excised from the same breast 5, 11 and 9 years respectively before cancer was diagnosed. The last of these three patients had also had a tumor ex-

cised from the other breast 15 years previously. One patient had had a tumor excised from the other breast 7 years before admission, one had had a radical amputation of the other breast 18 years before admission presumably for cancer.

MARITAL

Seventy nine patients 33.7 per cent had never been pregnant. Fifty three of the 176 married patients 30.1 per cent were unmarried. Of the 176 married patients 7 had had only abortions or miscarriages and 56 39 per cent had had only one child. Thus 36.7 per cent of this series had never nursed. There is no data as to how many of the patients with children had never nursed. The average number of children per married patient was 3. The findings agree with those of Lane Clayson who compared 500 women with cancer of the breast with a control series of normal women. To quote from her report: "The incidence of cancer of the breast is greater among single women and the less fertile married women i.e. those in whom the gland does not attain full function."

SYMPTOMS AND DURATION

It is common knowledge that the first symptom in this disease is most often the finding of a lump in the breast. This was so in 230 of this series. Four complained of bleeding and 5 of discharge from the nipple. The duration of symptoms varied from 2 weeks to 32 years. Seven patients had had symptoms 4 to 5 years, 6 had had symptoms 5 to 6 years, 4 for 7 to 10 years and 5 from 10 to 32 years. It seems reasonable to assume that a benign tumor preceded the malignant neoplasm in those patients who had noticed a lump for over 7 years.

TREATMENT

It is generally conceded that the radical operation of removing breast, both pectoral muscles, axillary contents and deep fascia en-

masse as early as possible in properly selected cases is the procedure of choice. Properly selected means that there must be no palpable supraclavicular glands, no adherent axillary glands, no internal or bone metastases, and that the tumor must be at least movable on the chest wall. When the operative risk is great because of some other disease or senility, or when there is ulceration and infection of the breast in an advanced case, simple amputation without removal of the pectoral muscles or axillary contents may be preferred. In the present series 5 patients were treated by operation, simple amputation of the breast being performed in 6 per cent of cases and radical amputation in 73.8 per cent. There were 3 operative deaths due respectively to diabetic coma, cerebral hemorrhage, and pulmonary embolus (1.3 per cent).

GROSS STATISTICS

Nine patients were not treated because of the advanced stage of the disease when seen on admission. One is untraceable, 7 died 5 months or less after being seen, and one died one year and two months later. The course of the disease from the time symptoms were first noticed until death varied from one year and one month to 7 years and 3 months. In 5 cases the course of the disease was less than one year and 8 months; in 2 it was 5 years and 3 months and 7 years and 3 months respectively. The course of the disease in the 25 remaining cases is shown in Table I.

Untraceable—20

TABLE I—COURSE OF DISEASES IN TWO HUNDRED AND TWENTY FIVE CASES

| P t p t p d | D t | L g th | W t |
|-------------------------|-----|--------|-----|
| One year or less | 34 | 5 | 8 |
| One to two years | 30 | 5 | 3 |
| Two to three years | | 5 | |
| Three to five years | 19 | 4 | 17 |
| Five to seven years | 1 | 4 | 6 |
| Seven to ten years | 5 | 1 | 7 |
| Ten to fifteen years | 4 | | 4 |
| Fifteen to twenty years | | | 5 |

Of the 166 patients traceable at the end of 3 years, 88 (53 per cent) were alive. Of the 130 traceable at the end of 5 years, 48 (36.9 per cent) were alive. Of 101 traceable at the end of 7 years, 6 (25.7 per cent) were alive.

RESULTS OF SIMPLE AND RADICAL AMPUTATION

After examining 8,000 cases reported in the literature of various countries, Lane Claypon found that after incomplete operation 5 per cent of cases were alive after 3 years, while after radical or complete operation 4 per cent survived the three-year interval.

Enough in studying 135 cases at the Massachusetts General Hospital for the years 1915 to 1920 inclusive reported 30 per cent of 1-year cures following radical operation.

Table II compares the results of radical and simple amputation in the present series.

TABLE II—RESULTS OF RADICAL AND SIMPLE AMPUTATION

| | Radical
amputation | Partial
amputation | Simple
amputation | Un-
known |
|-----------------------------------|-----------------------|-----------------------|----------------------|--------------|
| Total 3 years after operation | 128 | 53 | 38 | 55 |
| Traceable 5 years after operation | 100 | 37 | 30 | 36 |
| Traceable 7 years after operation | 84 | 74 | 17 | 16 |

Oddly enough, although Lane Claypon reports that 29 per cent of cases treated by simple amputation were alive at the end of 3 years, of the 38 cases in the present series traceable 3 years after simple amputation, 55.2 per cent were alive. This discrepancy can be accounted for only by the fact that a number of simple amputations were done on early cases and that some of the tumors were of a less malignant nature.

THERAPEUTIC X RAY

Daland has reported figures showing that in cases treated preoperatively with X rays, defective wound healing occurred in 54 per cent, while in cases untreated with X ray before operation, defective healing occurred in only 18 per cent.

Regarding postoperative X ray therapy, Greenough reported 21 cases of radical amputation without X ray treatment who lived an average of 3 months after operation, and 29 cases of radical operation followed by X ray who survived for an average of only 1 month.

In contrast to this, the results in the present series were uniformly better after postoperative X ray treatment, as indicated in Table III and later in this report.



MICROSCOPIC DEGREE OF MALIGNANCY

In recent years the literature has contained reports of series of breast cancer in which each case was classified as to degree of malignancy on the basis of the microscopic picture in order to determine whether or not a prognosis could be made in this manner. Greenough reported a series of 90 cases classified into four grades of malignancy by microscopic examination. He found that after 3 years 66 per cent of the class I or low malignancy group were living. After the same interval 47 per cent of the class II group and 3 per cent of the class III group were alive while none of the class IV or highest malignancy group had survived.

To gauge the degree of malignancy by microscopic examination requires considerable experience in the study of many sections. In general the criteria determining high as against low malignancy are lack of cell differentiation and uniformity, variation in size, shape and staining reaction, relative frequency of mitoses, lack of round cell infiltration and walling off, connective tissue proliferation, invasion of surrounding tissues and absence of regular cellular conformation and groupings, e.g. tubules (see Fig. 1, 2 and 4). It should be mentioned that at best the determination of the degree of malignancy is most difficult for it is rare to find a breast tumor the cells of which are homogeneous throughout. Usually pictures of varying malignancy can easily be found in the same tumor and frequently a metastasis has an entirely different appearance from that of the primary growth (see Figs. 3 and 3A). Clinically the same tumor seems to vary in its malignancy for hopeless cases may live a surprisingly long time while cases with a good prognosis may die from rapid unexpected recurrence. Furthermore late recurrences may not have the slightest resemblance in degree of malignancy to the primary tumor. The gauging of the degree of malignancy then is an estimate as to prognosis based on experience in examining many breast cancers microscopically.

Two hundred and five of the cases herein reviewed were graded according to their malignancy as determined by microscopic study, class I being low and class III high malignancy. At the time of grading the tumors

Gamma Ph t mic ph fa m f the b t f
l m l n y l s s I Th p t e t w l e d w l l
6 y e d s m th aft d al mput t h ing
h d \ y t atm t Th e x gland l m t
t s t th tum fop t Th l l how t l
sis d a well u o nded by fib t ssu Th e
nd ll filt at

TABLE III —RESULTS OF POSTOPERATIVE X RAY TREATMENT

| | | | | | | P | P | N | P | P |
|-----|-----|----------------|-----|---|-----------|----|----|----|----|---|
| | | | | | | P | P | N | P | P |
| T | abl | 33 | fte | p | t | 5 | 69 | 98 | 4 | 7 |
| T | all | 53 | fte | p | t | 37 | 54 | 83 | 77 | |
| T | bl | 73 | fte | p | t | 3 | | 73 | | 5 |
| (Th | bl | l d d b h m pl | d | d | l m p t t | | | | |) |

Table IV is composed only of cases treated by radical amputation

TABLE IV —RESULTS AFTER RADICAL AMPUTATION

| | | | | | | Pos | P | N | Post | P |
|---|----|----|-----|----|---|-----|----|----|------|----|
| | | | | | | pe | y | pe | y | t |
| T | ll | 33 | aft | p | t | 37 | 64 | 9 | 80 | 43 |
| T | ll | 53 | fte | p | t | 8 | | | 69 | 3 |
| T | bl | 73 | a | ft | p | t | n | 6 | 63 | |

RADIUM

It is conceded by most authorities that radium is of little or no use as a primary treatment for this type of cancer. For inoperable cases and recurrences X ray is considered to be the most effective treatment although radium has definite value in destroying superficial recurrent nodules. In 3 of 4 cases of this series in which it was used for this purpose radium brought about the complete disappearance of recurrent nodules.



Fig. 2 Class I carcinoma of the breast. The patient is well 10 months after a radical operation at which were found axillary gland metastases. This picture was taken to illustrate carcinomatous metaplasia in an area of chronic mastitis. There is considerable defensive fibroblast proliferation and round cell infiltration.



Fig. 3 Class I carcinoma of the breast. Simple amputation of left breast in 1909; simple amputation of right breast in 1910. In 1912 recurrent nodules were excised from left chest wall and the left axilla was dissected. Treatment by X-ray then followed. The patient was alive and well in 1927, 18 years after the first operation. The picture shows chronic mastitis and a carcinoma of low malignancy. The carcinoma looked like the comedo type in some sections; here it is more of a colloid type.

pathologically the clinical records of the patients were not consulted. The late Dr J. H. Wright, Dr H. F. Hartwell, and Dr Albert E. Steele very kindly examined nearly one-fourth of the sections. Dr R. B. Greenough very kindly examined a number of sections. One of the writers (Smith) examined nearly all of the sections a second time after a lapse of over 2 years and agreed with the previous gradings in nearly every instance (Table V).

TABLE V

| | CI | | PI | | P | | P | |
|-------------------------|----|----|----|----|----|----|----|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| No traceable at 3 years | 9 | 88 | 8 | 59 | 8 | 6 | 40 | |
| No traceable at 5 years | 8 | 87 | 5 | 64 | 42 | 44 | 13 | 6 |
| No traceable at 7 years | 6 | 83 | 3 | 49 | 28 | 6 | 35 | 8 |

AXILLARY GLANDS

A study of prognosis based on the presence or absence of axillary gland metastasis was made in classes II and III. Of the three class I cases with gland metastasis one died 9 years 10 months after operation and were well respectively 8 months and 17 years and 6 months after operation. The survival figures in relation to gland involvement and grade of malignancy are shown in Table VI which is made up only of cases treated by radical amputation—some having had post-operative X-ray.

TABLE VI—GLAND INVOLVEMENT AND GRADE OF MALIGNANCY

| | G I | | | | G P II | | | | G P III | | | |
|---------------------------------|-----|----|---|----|--------|----|----|----|---------|----|----|---|
| | Gl | d | P | t | Gl | d | P | t | Gl | d | P | t |
| | 1 | d | 1 | t | 1 | d | 1 | t | 1 | d | 1 | t |
| Traceable 3 yrs after operation | 29 | 48 | 4 | 26 | 84 | 5 | 42 | 26 | 3 | 9 | 89 | |
| Traceable 5 yrs after operation | 27 | 25 | 9 | 21 | 66 | 29 | 6 | 9 | 5 | 60 | | |
| Traceable 7 yrs after operation | 22 | 13 | 6 | 17 | 52 | 9 | 26 | 4 | 7 | 4 | 50 | |

GRADE OF MALIGNANCY AND DURATION OF SYMPTOMS

Since the duration of symptoms before operation is at best an inaccurate figure based as it is on individual variation and since it is a factor over which the surgeon has little control, no attempt has been made in this report to correlate it with the grade of malignancy and results, although it is accepted to be a factor of great importance.

DEGREE OF MALIGNANCY AND X-RAY TREATMENT

The cases in classes II and III treated by radical amputation with and without the use

of the X ray after operation were correlated with the degree of malignancy (Table VII)

TABLE VII DEGREE OF MALIGNANCY AND X RAY TREATMENT

| | | | CLASS II | | | CLASS III | | | P |
|---|----|---|----------|----|---|-----------|---|----|----|
| | | | Y | I | P | Y | I | P | |
| T | 11 | t | 3 | 1 | 1 | 1 | 1 | 1 | t |
| 1 | 11 | t | | 63 | 6 | 34 | 6 | 37 | 62 |
| T | 11 | t | | 6 | 4 | 0 | 3 | 5 | 3 |
| | | | | 4 | 6 | 30 | 5 | 9 | 69 |

Although these figures cover only a few cases they indicate not only that postoperative X ray treatment is of value in all cases but that its value is even greater in the more malignant grades

SARCOMA OF THE BREAST

There were 7 cases of sarcoma of a total of 34 cases 29 per cent. Three of these had never been pregnant and two had had only one child. The patients had noticed a lump in the breast for period varying from 7 months to 8 years. One patient died of pulmonary embolus after operation, two are untraceable, one was alive with an advanced recurrence 5 months after operation, one died 1 1/2 months after operation, one died 5 1/2 years after operation, having had twenty seven operations in all for the primary growth and for recurrences, and one patient was well 11 years after operation. On pathological examination 5 of the tumors were found to be fibrosarcomata and two round cell sarcomata. In 6 instances unmistakable intracanalicular or pericanalicular adenofibromata were found closely associated with the sarcomata.

ASSOCIATED PATHOLOGY

Chronic mastitis was practically a constant associated finding in the same breast with the malignant tumor. Chronic mastitis however is found so frequently in breast tissue and its microscopic appearance varies so widely that its significance cannot be estimated. In 5 cases tumors removed from the other breast at the time of the operation for cancer showed chronic mastitis. Five patients had papillary cystadenoma in the same breast with the cancer (1 was class I malignancy, 4 were class II) and one of these had a papillary cystadenoma in the other breast as well. In another case papillary cystadenoma was found in the other breast which had been removed at the same time as that containing the carcinoma. In studying many sections one gets the impression that chronic mastitis, papillary cystadenoma and carcinoma are stages in the same process. Although in the study of benign breast tumors it was common to find chronic mastitis and a pericanalicular or intracanalicular adenofibroma in the same breast, not once in this series was a pericanalicular or intracanalicular adenofibroma found associated with a carcinoma.

Twelve patients had the other breast amputated for carcinoma from 1 month to 4 years after the primary operation. So far as could be determined these were metastatic carcinomata. One patient had carcinoma of the cervix at the time of diagnosis of breast carcinoma, one had carcinoma of the endometrium 6 years later.

SUMMARY AND CONCLUSIONS

1. This report covers a clinical pathological study of 34 malignant tumors of the female breast of which 9 per cent were sarcomata, the remaining being carcinomata.
2. Nearly 60 per cent of patients were between the ages of 45 and 65 years.
3. A family history of malignant disease was given by 16.7 per cent of patients.
4. Nine patients had had previous breast operations, only one of which was for carcinoma, so far as could be determined.
5. The average number of children per married patient was 2.3. It was found that 39 per cent of patients had had only one child and that at least 36.7 per cent of the entire series had never nursed.
6. Practically all of the patients complained of finding a lump in the breast.
7. The duration of symptoms was usually under 3 years. Seven patients had had symptoms for more than 7 years, which makes it probable that a benign tumor antedated the malignant disease.
8. In untreated cases the course of the disease varied from 1 year and 1 month to 7 years and 3 months.



Fig. 3. Section of left axillary gland—same patient as in Figure 2. This shows how different a metastasis may appear from the primary growth. Neither the cell arrangement in this section resembles the cells or cell formation of the primary growth. This also appears more malignant than the primary growth.



Fig. 4. Section showing class III high malignancy type of carcinoma of the breast. There is very little histologic defense against the invading masses and alveoli. The cells vary in size, shape and staining reaction and mitoses are frequently be found under high power objective. The patient had had symptoms for 3 months; she died 5 months after a radical amputation.

In many cases it is very difficult to decide whether a case should be graded class III or class II, but after study in many sections one learns to detect differences. Photomicrographs do not bring out these differences with any satisfactory degree of clearness.

cent of class I cases, 28.6 per cent of class II and 8.6 per cent of class III cases.

13. In classes II and III the finding at operation of axillary gland metastasis affected the prognosis markedly.

14. After postoperative X-ray treatment the results were uniformly better both as to gross figures, to type of operation and to degree of malignancy.

15. In 6 of the 7 cases of breast sarcoma an intracanalicular or pericanalicular adenofibroma was found closely associated with the malignant tumor.

16. Although chronic mastitis is almost a constant finding in carcinoma of the breast it cannot be shown to have any etiological relationship. On the other hand there is frequent evidence that the papillary cystadenomata are often precursors of a malignant condition.

NOTE.—In this paper the study of the grades of malignancy was undertaken at the institution of Dr. R. B. Greenough and to him the late Dr. J. H. Wright and Dr. H. T. Hartwell for their interest and assistance the writers express their gratitude.

9. The operative mortality was 1.3 per cent.

10. In this series 53 per cent of all operated upon traceable cases were alive at the end of 3 years, 36.9 per cent were alive at the end of 5 years and 25.7 per cent were alive at the end of 7 years. The percentage of absolute cures cannot be determined because some patients are untraceable and because recurrences may occur years after an apparent cure. Of the 13 patients known to have lived longer than 10 years after operation 2 died of recurrent carcinoma between 11 and 12 years after operation.

11. Contrary to expectations the 3 and 5 year results in those cases treated by simple amputation were practically the same as in cases treated by radical amputation although the 7 year results were not as good. Since this finding is exceptional and probably a coincidence it should not be construed to favor simple in preference to radical amputation.

12. The degree of malignancy may be determined in any given case on the basis of the microscopic examination and an approximate prognosis may be made due consideration being given to the duration of symptoms to the stage of the disease when seen to the presence or absence of axillary metastasis and to the ability of the operator. In this series there survived the 7 year interval 83.3 per

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THE MANAGEMENT OF URETERAL INJURIES WITH A DISCUSSION OF THE SURGICAL INDICATIONS IN PATIENTS WHO REQUIRE URETERAL TRANSPLANTATION¹

ARTHUR H CURTIS M D F A C S CHICAGO
F m th Gy ec l ID p m t f S L k H p t l

FRANK BILLINGS has an axiom to the effect that the best way to secure a satisfied patient is to find out what he wishes and then treat him in accordance with his desires. I know very well what everyone in this audience would wish from me were he empowered to speak—it would be a carefully concentrated paper free from exhaustive explanations and discussion.

Introductory to the substance of my offering I wish to call to your attention that three men here tonight have done a major portion of the world's greatest work in ureteral surgery. Franklin H. Martin unexcelled benefactor in the advancement of medical organization through his pioneer work in animal experimentation evolved a method of ureteral implantation into the bowel which in its chief features embodies the principles of Coffey's technique. The experimental and clinical work of Dr. Coffey and the achievements of Charles Mayo in human subjects require no emphasis at this time. The outstanding work of E. Starr Judd, William E. Lower and Arthur L. Chute also deserves special recognition. The experimental work of C. M. McKenna which has just been reported to you here tonight is of unusual interest and importance.

MANAGEMENT OF THE INJURED URETER

What shall be done with a severed ureter the injury being recognized at the time of the operation?

1 If a ureter is divided during the course of a hazardous or markedly prolonged operation and it is chiefly in such cases that this calamity occurs I am unqualifiedly in favor of ureteral ligation without attempt at transplantation or repair. (It is assumed that palpation reveals an apparently healthy kidney and ureter on the opposite side.) Experience has shown that patients subjected to ureteral ligation rarely require subsequent surgical intervention and life expectancy is not materially shortened.

2 If the operation has *not* been notably hazardous also in selected hazardous cases in which there is evidence of notable kidney ureter pathology on the uninjured side restitution of function of the injured ureter appears indicated.

Transplantation of the ureter into the urinary bladder is the accepted procedure of choice in those unusual cases in which the divided ureter is of sufficient length to permit implantation without tension. As a rule this is not feasible.

An apparently ideal method of management of a severed ureter is restitution by end to end anastomosis (by interrupted fine catgut sutures which do not enter the lumen) over a snugly fitting fine rubber tube (e.g. a small urethral catheter) the upper end of which emerges from a slit in the ureter above the anastomosis and projects through a stab wound in the flank. In women the tube need not emerge from a ureteral slit instead the



Fig. 1. The top half of the kidney and ureter of a dog killed 9 months after operation. Site of ureteral fistula in left ureter. (Courtesy of Dr. Bump and Cr.)

lower end may extend downward into the bladder from which it is subsequently removed through the urethra.

Temporary deviation of the urinary stream above the anastomosis is essential to success. This is accomplished by means of another fine rubber tube or small urethral catheter which is inserted through the ureteral slit and extends upward in the direction of the kidney. This tube also projects through the stab wound in the flank and drains the entire urinary stream until removal of both tubes eight or ten days later.

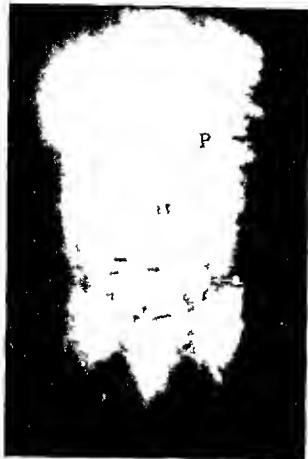
The feasibility of this procedure has been demonstrated experimentally beyond all question by Warner S. Bump of the Gynecological Department of Northwestern University Medical School in conjunction with Stanley M. Crowe. Their work was undertaken at the suggestion of Dr. L. L. McArthur who performed the first operation upon a human subject. Of a total of six dogs which survived operation and in which the drainage



Fig. 2. Pelvoureterogram of patient 5 months after anastomosis of the cut ureter. Normal kidney pelvis and site of ureteral anastomosis.

tubes remained in position every one recovered without urinary tract infection and with perfect restitution of ureteral continuity without necropsy evidence of ureteral stricture (Fig. 2). Of the control animals in which urine was permitted to flow through the normal channel during convalescence all developed stricture of the ureter at the point of anastomosis.

This technique has been employed in one of the two cases of cut ureter which have occurred on our service during the last year. The patient was operated upon in November 1927. Pyeloureterography five months after operation and again after ten months revealed restoration of ureteral continuity and a normal kidney pelvis (Figs. 2 and 3). Dye tests, urine examinations and urine cultures indicate normal kidney function. I believe that this is the only recorded case in which end to end anastomosis of the ureter has been followed by clinical proof of normal kidney-ureter function.



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What shall be done with an injured ureter the injury being first recognized during post operative convalescence?

It is impossible to estimate the percentage of deaths attributable to intra abdominal extravasation of urine resultant from ureteral injury it is considerable. We all know, however, that a majority of the patients live that they drain and that they are continuously uncomfortable.

I wish to emphasize that the patients with leakage of urine tend to progress to spontaneous cure due to the gradual development of ureteral stricture. In experimental animal the flow of urine is practically always insufficient to prevent spontaneous closure of the injured ureter. In human subjects the results are not so ideal but watchful waiting usually suffices. Restriction of liquid intake and careful manipulation at the supposed

site of injury are possible aids in promoting closure.

In the event that surgical intervention eventually becomes necessary the indications for operation vary greatly according to the individual case. In an otherwise healthy patient not notably obese and probably free from extensive adhesions abdominal section may be given preference over nephrectomy. My procedure of choice in such a case would be ureteral anastomosis. That being impossible in the presence of a healthy second kidney and ureter I would ligate the ureter. It is my belief that future experience will condemn the intestinal transplantation of an injured ureter in patients who have a normally functioning, apparently healthy kidney and ureter on the opposite side.

PROBLEMS IN URETERAL TRANSPLANTATION

I most heartily approve of ureteral transplantation and am a warm advocate of Coffey's original technique in the performance of this operation.

A limited personal experience indicates that the cases which require transplantation are relatively rare. This statement needs special emphasis because the operation is a difficult and dangerous one in the hands of those who perform it infrequently. The chief indications for ureteral transplantation are irreparable injuries of the bladder total cystectomy cystitis dolorosa and intolerable inflammation of the bladder incident to the presence of residual urine. Unilateral ureteral injury is excluded from this group.

Simultaneous transplantation of both ureters has not been attempted on our service at St. Luke's Hospital because we have felt that it is too hazardous. Added experience on the part of other may change our views.

In closing, I wish to direct your thoughts to certain features of technique and certain queries which arise.

1. Preliminary ureteral catheterization when feasible expedites finding the ureters.

2. The Trendelenburg posture with the bowel well walled off by a rubber pack simplifies the operation.

3. Obese and barrel shaped patients are particularly unfavorable subjects.

A ureter which is under tension when it is transplanted offers a serious menace leakage of urine means possible death of the patient

Despite gentlest manipulation and most careful technique transplantation of a ureter is often followed by extensive adhesions. In the event that operation for transplantation of the second ureter reveals bad adhesions, also in patients who are poor surgical risks likewise in those who for various reasons are difficult to operate upon it may be desirable to be satisfied with a single transplanted ureter. In fact serious consideration should always be given to the possible desirability of ligating the second ureter provided palpation from within the abdomen confirms other indications of satisfactory function on the already transplanted side. Particularly in case of anticipated total cystectomy for bladder cancer it would appear most logical to make preliminary transplantation of one ureter with subsequent ligation of the second

ureter at the time of removal of the bladder

A final word of warning. Ureteral transplantation into the sigmoid or rectum offers an excellent cure for constipation. A painless liquid evacuation occurs every several hours. Occasionally however there is persistently delayed evacuation or partial retention of feces and urine with associated resorption of toxic urinary products from the bowel. Repeated colonic flushings prevent the development of chronic uramia in these cases.

CONCLUSION

Uretero-ureteral anastomosis is an excellent procedure in selected cases of ureteral injury. Ureteral transplantation into the intestine according to the technique of Coffey is of great value in patients in whom the bladder is no longer serviceable as a urinary reservoir. Although both of these operations are of inestimable value it must be borne in mind that the cases in which they are indicated are relatively rare.

MALIGNANT BONE TUMORS¹

P. OFF. VITTORIO IUTTI B. LO NA ITALY

THE American College of Surgeons has an established tradition whereby the work of its annual Congress shall be inaugurated by the pious rite of evoking the memory of a great surgeon and famous master John B. Murphy. The Board of Regents has this year decreed that this signal honor should be entrusted to me and it is with deep respect for this important mission that I have come to offer my humble contribution.

But at the actual moment in which I prepare to fulfill my undertaking I feel that I must appeal to your courtesy and indulgence. I cannot offer a perfect eulogy of John B. Murphy because I never had the privilege of meeting him. I cannot entertain you with a subject of general interest because I am the modest devotee of one specialty. For these reasons I hesitated long before I accepted the generous and cordial invitation of your Director General but my diffidence was ultimately overcome by the desire not to let slip so favorable an opportunity of demonstrating both my profound admiration for this great American surgeon and also my gratitude as an Italian to the American College of Surgeons for honoring my country a second time by entrusting the task of delivering the Murphy Oration to a surgeon of my country.

I believe that it is not necessary to have known John B. Murphy in order to appreciate the great role which he played in the evolution of modern surgery. Certainly those like myself who were not privileged to meet him can not but have missed the illumination which radiated from his complex personality and the profitable example of his exceptional skill. But his real reputation—that for which he is admired as one of the most illustrious exponents of modern surgery—is founded on his writings. Every one of his contributions either opens up a new field or clears up some confused subject. He is perhaps the last of a generation of general surgeons who were able to cope with the whole field of medical practice in all its complexities and who have laid

the foundations of modern specialization. Murphy was a pioneer in every branch of surgery but as Bastianelli has already remarked in none did he find greater opportunity to demonstrate his genius than in the field of the surgery of the bones and joints. In this he was not only a pioneer but also a constructor and I believe that were he among us it would not be unpleasant to him to find his memory honored by a discussion on one of the subjects which interested him most and in connection with which the American College of Surgeons, the heir of his thoughts and a pillar of his organization, has created that admirable research organization which goes by the name of the American Registry of Bone Sarcoma.

I hope that you will not accuse me of presumption if I venture to lay before you my views on a subject which has been studied in your midst by surgeons such as Bloodgood and Coley and by pathologists such as Codman and Ewing and also if I dare to draw my conclusions from statistics which cannot be compared with those utilized by Kolodny. It is only because of my admiration for the work of American surgeons and pathologists that I wish to give to you the fruits of my own experience in the hope that they may prove of use in the solution of a problem to which your countrymen have devoted so much energy and knowledge.

DIAGNOSIS

It is my opinion that the problem of neoplasia of the skeleton clinically considered is first and foremost a problem of diagnosis. We must confess at once that if we know nothing of the essence and causes of tumors in general in the case of bone tumors we have not even a clear clinical picture.

The name of *osteosarcoma* covers an ill-defined pathological condition of which we know only a few really characteristic features that of *giant celled* tumor refers to a pathological growth which is not yet known to be long for certain to the neoplastic diseases which is considered benign yet which often



Fig. 1

Fig. 2

Fig. 1 Osteogenic sarcoma. Sun ray arrangement at the apex of the new formed bone.
Fig. 2 Endothelial myeloma (Ewing's sarcoma). Note the location in the shaft the sun like arrangement of the



Fig. 3

Fig. 3 Endothelial myeloma. Although tumor affects the vertebral body the intervertebral discs remain intact.

cannot be distinguished from a malignant blastoma. Primary and secondary tumors assume the appearance of inflammatory processes in the same way that infectious and dystrophic diseases imitate the structure of a neoplasm.

So much for the diagnostic problem considered by itself. But we all know that in respect to malignant tumors early diagnosis is still the only certain way of ensuring a radical cure. Therefore we repeat the problem is primarily one of diagnosis and it is to the attainment of early and correct diagnosis that those who are investigating the subject should direct their efforts.

Thirteen years ago John B. Murphy wrote "We believe that in cases of sarcoma the diagnosis can and should be made entirely by the history and with the aid of skiagraphs." Today this truth enunciated by Murphy still stands. The clinical history and the radiogram are the foundation stones of the diagnosis. More than half the errors of diagnosis and two thirds of the delay in making a correct diagnosis are due to inadequate attention to the history of the case, to incomplete examination of patient and to delay in obtaining skiagraphs or their incorrect interpretation.

In regard to the clinical history I would emphasize the importance of one factor in the

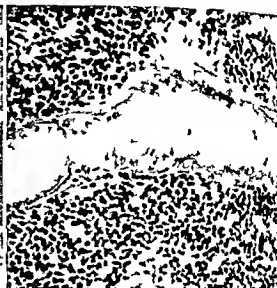
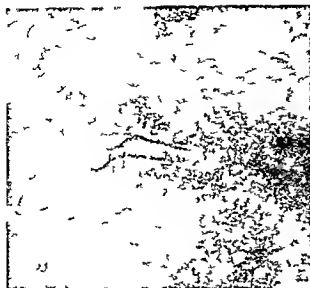


Fig. 1. Histological section of a tumor (Figs. 1-3).

Fig. 2. Histological section of a tumor (Figs. 1-3).

evaluation a factor which the histories reveal with great frequency and which has been the subject of much discussion—that is, trauma.

Any one with even moderate clinical experience must have been struck by the frequency with which history of trauma is found in the case of a tumor. Even if one discards everything doubtful or inconsistent which might not seem still there remain a number of fairly convincing in their evidence as to convince of the truth and importance of the fact in the cause of such tumors. No writer on this subject who have dealt with ample material from Gross to Meyerding from Schelyntz to Clevy has failed to give due consideration to this important phenomenon. In our statistics on malignant tumor trauma is recorded in 47.16 per cent of the cases. It should be understood that if the connection between trauma and tumor is accepted it must be based on indisputable fact. In this connection I accept the premise laid down by Selyntz long ago and better defined by the results of recent research which demonstrate that isolated direct trauma usually induces a tumor of the peripheral layers of the bone with a short latent period, whereas indirect trauma, open wounds, distortions and fractures are causes of sarcomata with a long latent period and a central situation.

SYMPTOMS

No specific symptoms are associated with malignant bone tumors. In my report to the Società Italiana di Ortopedia 1927 I said that if one wishes to discover an osteogenic sarcoma at its origin one ought to live constantly on the lookout for it. One's suspicion may be confirmed by a skigram in which case one will have succeeded in diagnosing a tumor of which there was no suggestive sign except those common to all ordinary lesions.

It has been said that pain is one of the most common and most characteristic signs of a neoplasm. I think that this is an overstatement for one can never attach to a subjective phenomenon like pain the importance which we associate with a pathognomonic symptom. More than pain itself it is the peculiar quality of the pain which should make us think of a sarcoma—that is a pain which is intense, dull, constant and localized but relieved by other local signs. But in tumor the intermittent pain is associated with the rise not suggestive of neoplasm inflammatory condition. On the other hand one finds that tumors of the pelvis, vertebra induce pain which acts of ordinary sciatica.



Fig. 6 Spine metastasis of a cancer of the testis

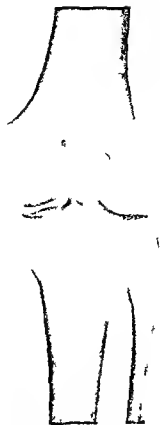


Fig. 11 Border line giant cell tumor

In my opinion importance should be attached even more than to pain to the question of the *location of the tumor*—a tumor of the diaphysis is almost always an osteogenic sarcoma of the periosteal type or it is an endothelioma—a tumor of the metaphysis if it is not innocent is a sarcoma of the central type an epiphyseal tumor in the great majority of cases is a giant cell tumor. Tumors of the astragalus and os calcis are either giant cell tumors or else myxomata. A localized tumor of the vertebral column unless it is secondary is either an angioendothelioma or else a giant cell tumor.

The location of the growth therefore only enables us to distinguish one type of tumor from another. The differential diagnosis which is most important for the surgeon is not to determine the type of tumor but the much more difficult task to decide whether the condition is due to a tumor or an inflammatory disease also whether the tumor is primary or secondary. Diseases of a definitely infectious nature such as osteomyelitis syphilis, and tuberculosis also dystrophic diseases,

both localized and diffuse like Paget's disease and osteitis fibrosa all these may simulate a tumor just as an endothelioma may take on the aspect of osteomyelitis. And how many tumors that we persist in regarding as primary are possibly none other than isolated metastases of visceral neoplasms. The history the progress of the case the physical examination and biological tests may give valuable information toward the differentiation and may sometimes by themselves alone decide the diagnosis but in such cases the last word will always remain with the radiologist.

I do not believe this last point can be disputed. Even the pathologists are convinced of this truth. At the present day the surgeon can be helped in his diagnosis only by those few pathologists who are equally competent to interpret the histological preparation and the X-ray picture. The great authority on this subject which Codman and Ewing have acquired comes from their vast experience in both pathology and radiography. In a report to the Congress on Cancer held last July in London, Ewing said: "The great majority of



Fig. 1. A roentgenogram of a bone sarcoma. The tumor is the dark, irregular mass in the center of the image.

bone sarcoma can be detected and the clarification made with reasonable accuracy on radiographic signs. We may today leave unopened and ignored all pathological treatises in which the chapter on tumors of bone is treated by authors who are not expert in reading X ray pictures.

But is it true that definite signs exist which enable us in every case to distinguish by means of X ray examination a tumor from an inflammatory process or a primary tumor from a secondary one? Certainly not! The X ray signs are only relatively specific. A bone reacts against a tumor in the same way that it does to destructive stimuli which are non-neoplastic or even to regenerative processes. For example in the callus of a fracture. If we delude ourselves by picking out X ray signs a pathognomonic it is because we have more or less learned to judge of their relative value that is of the comparative value of certain manifestations. Is it not by an analogous process that we judge the so called specificity of the cell in making the histological diagnosis of tumor? In spite of this difficulty comparative analysis has reached a stage of accuracy which allows us to gain from a study

of the X ray findings diagnostic information of capital importance. No other method of investigation enables us to recognize in so rapid and comprehensive a way the anatomical features of the tumor that is its situation, extent, structure and relations. Of course one must not overestimate the importance of this method of investigation. One must not demand of it more than it is able to give. Although in certain cases it alone suffices for the diagnosis yet in many others it forms only one part of it. But one can never in it too strongly that much more frequent and extensive use should be made of the X ray than is usual.

It is discouraging to see that although the average surgeon always demands a roentgenogram of a fracture which could probably be quite well recognized and treated without one yet very few feel it necessary to make a roentgenogram of the seat of an unexplained pain although this is often the first and only symptom of a sarcoma.

The stress which we lay on the X ray in the diagnosis of sarcomata of bone does not imply that we fail to appreciate the value which biopsy always has had and will have. On the contrary we are absolutely convinced that it always constitutes the final court of appeal. But owing to circumstances it is rare that biopsy can be of real value to the surgeon or patient because firstly it is always difficult often impossible even for the most experienced pathologist to interpret the structure and clinical significance of bone tumors and of the diseases which have affinity with them.

An expert pathologist like Dr. MacCarty of the Mayo Clinic has said justly. The differentiation of pathological conditions and their clinical interpretation in the light of the best interests of the patient is an art. How many pathologists at the present day possess this art in the wide and difficult field of disease of the skeleton?

Few indeed I believe.

But it is not entirely the pathologist's fault. One must acknowledge that the pathologist is rarely in a position to make a correct and satisfactory decision. Of two sarcomata as also some giant cell tumor never consist of a homogeneous mass of the epithelial tumor

usually do but of a conglomeration of diverse elements scattered in disorderly fashion so that the structure of the tumor in one place may be totally different from that in another. For a correct diagnosis it is essential to have a complete examination of all parts of the tumors which is seldom possible is even more rarely carried out and often results in loss of precious time. By having neglected to examine completely a tumor which I regarded as benign I lost a patient whom I might have saved by an amputation. And what shall we say of the efficacy of those partial examinations which are so common and in which the pathologist is compelled to decide on the nature of the disease from a fragment of tissue which can reveal only a limited aspect of it? I am not among those who reject biopsy on account of the damage it may do damage which can be avoided by correct technique but among those who reject it because I believe that in the great majority of cases biopsy is found to be inadequate. Moreover this skepticism over the real value of biopsy which is felt by many surgeons is shared by a pathologist like Lwing who is rightly considered an authority on the diagnosis of bone tumors.

I should like to linger in my analysis of the diagnostic problems of bone tumors so great is the importance that I attach to them but I must profit by the short time which yet remains to me in order to consider some other aspects of the subject.

CLASSIFICATION

Hitherto classifications of bone tumors have been based exclusively on histological considerations. But the X-ray in helping us to follow the whole natural history of the tumor and thus giving it a more complete entity has produced a revolution in the field of the clinical pathology of bone tumors and so necessitated a revision of the old classifications. To the Committee of the Registry of Bone Sarcoma is due the credit for carrying out this revision. Whatever may be one's opinion of the classification suggested by the Registry to my mind it has fundamental value on the score that it is the first attempt at classification in which thanks to the happy collaboration of surgeons and pathologists



Fig. 9. Section taken from the tumor represented in Figure 8.

weight has been given to clinical and X-ray as well as to histological criteria. I do not agree entirely with this classification in respect to the terminology and the order of the various groups. I think that certain tumors for example the angiomata do not deserve to be placed in a distinct group. On the whole I prefer the classification followed by Novak, Josseland and Tavernier a classification which certainly was formed under the influence of that of the American Registry and I agree with the more schematic one shown by Lwing at the recent Cancer Congress. None the less the attempt made by the American Registry is worthy of the greatest praise because it has cleared the field of conceptions that no longer accorded with facts and also because it has reawakened interest and discussion over a subject which had fallen into oblivion.

Endothelioma. A place in modern classification is given to a family of tumors that of the endotheliomata which were not previously noted and this innovation has led to much debate. To some authors such as Lecenc, Masson Ribbert these tumors do not seem to form an oncological entity to others such as Delbet they only represent metastases from primary gland tumors. I have no time to enter into the merits of this question but as the



1 Metastatic tumor of the hand from the
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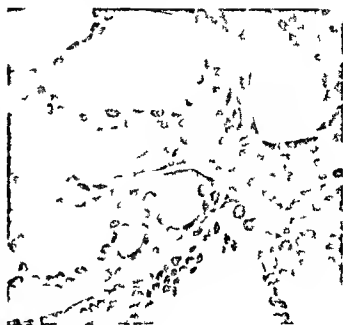


Fig. 9. Section taken from the tumor represented in Plate 5.

weight has been given to clinical and X-ray as well as to histological criteria. I do not agree entirely with this classification in respect to the terminology and the order of the various groups. I think that certain tumors for example the angiomata do not deserve to be placed in a distinct group. On the whole I prefer the classification followed by Novak, Jossier and Tavernier a classification which certainly was formed under the influence of that of the American Registry and I agree with the more schematic one shown by Ewing at the recent Cancer Congress. None the less the attempt made by the American Registry is worthy of the greatest praise because it has cleared the field of conceptions that no longer accorded with facts and also because it has reawakened interest and discussion over a subject which had fallen into oblivion.

Endothelioma. A place in modern classification is given to a family of tumors that of the endotheliomata which were not previously noted and this innovation has led to much debate. To some authors such as Lecene, Musson, Ribbert these tumors do not seem to form an oncological entity to others such as Delbet they only represent metastases from primary gland tumors. I have no time to enter into the merits of this question but as the



Fig. 1. B. met. t. (t) f.



Fig. 2. B. met. t. (teolytic) of ca.

result of my clinical experience I feel bound to say that such a distinction is actually confirmed by facts certainly as regards that endothelioma which Ewing has defined by the name of diffuse endothelioma or endothelial myeloma.

It is still a matter for discussion whether this tumor is formed as Ewing believes from the perivascular endothelium or from endothelial cells of bone marrow or whether as Kolodny and more recently Oberling have asserted it arises from the reticulo-endothelial system whether it belongs to the neoplastic disease or whether it ought to be included under those diseases which are now called pre-tumoral or paratumoral but what is beyond dispute is that the endothelial myeloma has its own peculiar characteristic that is to say clinical radiological and structural peculiarities which enable it to be distinguished from other tumors and from non-neoplastic diseases of bone. Any one who has observed even one of these cases can have no doubt on the matter and cannot fail to recognize that this discovery has thrown new light on the obscure pathology of bone tumors. From the moment that the theoretical existence of this form of tumor was announced there have been published an increasing number of cases which have confirmed the fact of its existence while observations multiply showing the diagnostic errors due to the very close resemblance between endothelioma and certain inflammatory

processes of bone more particularly osteomyelitis.

But is Ewing's tumor a primary tumor? This seems to me at present the more important question and most difficult to settle. Its extreme sensitiveness to the X-ray would make one regard it as a secondary tumor for it is known that the metastases of a bone tumor have a similar sensitiveness. In one case in my series neoplastic foci appeared first in one tibia and then in the other and in the femur preceded shortly the appearance of a tumor which occupied the posterior mediastinum and which showed the same sensitiveness to X-rays as did the bone foci. This roused my suspicion that these foci were only metastases from a primary tumor situated in the mediastinum.

Secondary tumors. Therefore I believe that it is not improbable that we shall be better informed about the origin of endothelial myeloma when we have gathered more information about the frequency and the ways of distribution and of evolution of secondary tumors. It has long been known that gland tumors more especially the mammary, thyroid, prostate and suprarenal frequently give metastases in bone. But that there exist carcinomatous and sarcomatous tumors of bone which have originated from visceral blastomata which cannot be diagnosed clinically is a more recent discovery which is daily gaining wider acceptance. This subject

was dealt with at length by Prof. Alessandri in your Congress of 1906. In his recent report to the American Orthopedic Association, Coley expresses surprise that in my statistic there is such a striking number of secondary tumors, but the reason is that my experience with many cases has taught me to classify as secondary tumors those localized and diffuse lesions of bone the nature of which remained uncertain only because the primary tumor was not to be found on clinical examination but was discovered at the postmortem examination.

In other words, the idea that our conception of secondary neoplasms must be widened is one which is daily gaining ground. Thus alone can one explain phenomena which otherwise seem inexplicable, and thus we may perhaps one day make clear the reasons for the structural relationship which exists between certain neoplastic bone syndromes and others which hitherto have been considered as inflammatory or as dystrophic and which perhaps we ought to accustom ourselves to class as pretumoral or paratumoral.

TREATMENT

And now one word as to treatment.

I have had no experience with radium, and a very limited one with Coley's toxins. I have used radiotherapy in association with surgical treatment, and also have utilized it as the only method in dealing with inoperable tumors. I have observed the great value of radiation for the relief of pain, especially in diffuse sarcomata. I have noted the extreme sensitiveness of soft sarcomata, more especially the endotheliomata, for which a few doses suffice to clear away all external evidence of the tumor. But this disappearance is only temporary. Indeed, I have gained the impression that in some cases radiation hastened the formation of metastases. Perhaps in view of their great sensitiveness to X-rays these tumors could be cured if they were treated early with intensive doses and a wide field of exposure.

In osteogenic sarcoma, I have had some rare successes with tumors of the fibromatous type, but no cure with the periosteal, subperiosteal, or teleangiectatic.

I have had no experience of radiotherapy in giant cell tumors, which I have preferred to treat up till now by surgery in the form of curettage or excision.

In regard to these latter tumors, I may say that I also have observed with what relative frequency relapse occurs after curettage, and how, though rarely, they may produce metastases. What Kolodny has said in this connection is certainly true, namely, that these tumors are benign in the oncological sense of the word, but clinically they may offer very serious problems to the surgeon. Possibly surgical treatment is not the best method of handling these tumors, the tissues of which are so sensitive to mechanical stimuli. It seems logical as proposed by Tving to treat them in the future with radiation alone.

Surgical intervention is still our sheet anchor in the treatment of osteogenic tumors. The few successes which my statistics show represent cases treated with amputation or disarticulation. As I have no means of judging how much radiation immediately after the amputation contributed to the success, I cannot give definite reasons for the results. They are evidently influenced by anatomical, biological, and even accidental conditions which escape us. Still it is logical to suppose that an early intervention will be more successful than a late one, but early treatment is rarely practicable. In most cases the tumor is recognized as such only when it is fully developed, or if it is recognized early, the patient very often refuses amputation.

No patient hesitates to undergo resection of the stomach or intestines on the mere supposition of a cancer, but one must work hard to convince a patient with extensive osteosarcoma of the necessity of an amputation.

Uncertainty in the diagnosis, hesitation on the part of the patient, reluctance of the surgeon to undertake a mutilating operation, inevitable and almost always useless attempts to cure by means of conservative measures, cause us to lose precious time and take from the radical operation most of its chances of success.

The results of the treatment of bone sarcoma are certainly discouraging. In our present state of knowledge, our own means of

improving them is by making better use of the means at our disposal

It is much to be hoped that X-ray therapy has not yet exhausted its resources in the treatment of bone sarcoma. As for operative treatment not much can be expected from the perfecting of technique its efficiency will increase step by step as we learn to discover the first manifestations of tumors and to operate without delay

I hope you will excuse me for having merely touched on a few points in the complex subject which I chose but in order to say much more I should have had to abuse your kindness too much

I shall have attained the end I desired if I have succeeded in fixing your attention on

a problem of great scientific and practical interest

Certainly in the study of tumors we have reached the dead point which we can pass only on the day when we shall be better informed about their intimate nature. By what routes we shall reach the discovery of the causes of tumors it is impossible to foretell but one thing is certain and that is that this discovery neither will be the fruit of chance nor will it be a miracle but it will be the logical conclusion and reward of hard work and intensive research

Let us therefore be inspired by the example of John B. Murphy and follow tenaciously the road which shall lead us to the desired goal



CHORDOMA

A REPORT OF TWO CASES: A MALIGNANT SACROCOCCYGEAL CHORDOMA AND A CHORDOMA OF THE DORSAL SPINE¹

MATTHEW J. HULTON, M.B., CH.B., CLASCO, W. SCOTLAND
S. A. I. I. R. S. L. J. F. C. I. A. S. W. L. G. M. J. C. I.

ALCHIBALD YOUNG, B.Sc., M.B., CH.B., CLASCO, W. SCOTLAND
L. H. I. F. I. C. I. F. C. I.

ONE of our purposes in offering this short communication to the Clinical Congress of the American College of Surgeons is to remove the reproach of having the name of one of us included in the now considerable literature on the subject of chordoma against a still unpublished observation. The case which we have to report first is included in the bibliography attached to the paper on Chordoma published in the January 1916 number of *The Journal of Pathology and Bacteriology* by Professor Matthew J. Stewart (Leeds) and Dr. J. I. Morin (Quebec). It appears there as an unpublished observation against the names of A. Young and R. Muir. The specimens were shown by Professor Muir at a meeting of the Pathological Society of Great Britain and Ireland January 1915.

In publishing now a full record of the case we are able to record its later history and to describe the condition when a somewhat late recurrence forced for further operative intervention.

We take the opportunity of including along with the report of the earlier case the account of a second with which we have had to deal more recently which has the additional interest that the region of the spine involved, namely the dorsal spine, has not hitherto been found to be the seat of chordoma at least we have been able to find in the literature no record of a similar case.

This second case has been included already in a paper by Dr. D. I. Cappell of the pathological department of the University of Glasgow to be published in *The Journal of Pathology and Bacteriology* for October 1918, along with accounts of two other cases of chordoma affecting the vertebral column, namely of the cervical spine. We report the

first of these cases here independently but we desire to acknowledge our indebtedness to Dr. Cappell for the description of the histological findings and for his interest in the case.

In choosing the venue for our contribution we have been influenced by the fact that American surgical literature though it contains several of the earlier examples of the condition is singularly lacking in recent records of chordoma.

CASE OF MALIGNANT CHORDOMA OF THE SACROCOCCYGEAL REGION

A female aged 49 years was admitted to the Western Infirmary, Glasgow, on May 11, 1914, with a very large tumor bulging from his sacral region. He was sent in by Dr. John Miller of Greenock, from whose letter the following may be quoted:

The condition extends over several years and an operation was performed initially when the report stated that the tumor removed was inflammatory. The tumor rapidly grew and 6 months ago it was certainly the size of an adult's head. Prolonged X-ray applications have reduced it to its present size. When it was seen 6 months ago I inserted an exploring needle with a resulting hemorrhage which lasted for several days. The tumor at the time was very soft suggesting fluctuation. With its decrease in size it has become very hard. My view is that the condition is a sarcoma.

The particulars given by Dr. Miller may be amplified. Inquiry elicited the fact that 10 years before at the age of 29 years the man fell heavily on his buttocks. It was not however until 1900 when he was 45 years of age that anything out of the normal was noticed. About that time that is 4 years before admission pain of a dull type began to be experienced in the sacral region and within 6 months of the first appearance of the pain the onset of a swelling was observed. This swelling grew with some rapidity until it reached the size of a coconut. Some months afterward in the Greenock Infirmary the tumor was incised and material was removed for histological examination. This examination made by a Clinical Research Institute resulted in a report that the tissue was of an inflammatory nature. Only a portion of the tumor was



Fig. 1. (Left) The tumor in the position of retraction. (Right) The tumor in the position of extension. The tumor is shown in the position of extension.

remained and the growth of the mass continued to increase. Later under the influence of prolonged X-ray treatment considerable retrogression of the tumor is said to have taken place and as indicated in Dr. Miller's letter the tumor was explored with the result that alarming hæmorrhage took place which continued for some days. Again the following certain diminution in size was taking place from the soft almost fluctuant consistency to a considerably harder. The exploratory incision was carried out in November 1903 and X-ray treatment was resumed afterwards in the following month. Infirmed with some further diminution in size.



Fig. 2. (Left) The tumor in the position of retraction. (Right) The tumor in the position of extension. The tumor is shown in the position of extension.

Condition on admission to the Hospital. The tumor which as fully the size of a child's head was situated in the sacral region bulging more to the left than to the right. It was very little movable on the sacrum and the skin over its surface was somewhat closely attached to it. At one spot there was a deep dimple which suggested in appearance a site of the point of dimple of congenital origin. The dimple however represented the result of the puncture which had been made by the exploring needle 6 months before (Fig. 1 insert).

The tumor was hard throughout though varying in degree of hardness at different places. There was no suggestion of fluctuation at any place. Apart from the bulk of the tumor and the inconvenience directly traceable to this there were no marked symptoms of any kind beyond occasional slight pains down both lower limbs and an indefinite sensation of ineffective defecation. Rectal examination showed that the tumor bulged also into the pelvic cavity and that it had a close relation to the all of the lower rectum. At no point however was there any indication of actual involvement of the rectum. All in the growth and the palpating finger seemed to be able to move the mass freely upon the mass of the tumor outside it. The main landmark was varicose veins in both legs and the scars of old varicose ulcers on the left leg.

X-ray examination of the tumor and of the lumbosacral spine at this time was somewhat inconclusive. The lower end of the sacrum was not available from the tumor. The outline of the coccyx was quite definite. It was thought that



Fig. 5 Showing the stroma between several adjacent alveoli the margins of which are seen. The blood cells have rather thin walls and the connective tissue is infiltrated by round cells and phagocytes containing altered blood pigment. The peripheral cells in the alveoli are well preserved and are seen to form long strands with an irregularly radiate arrangement. (Case 1)



Fig. 6 Magnification of the larger alveoli which have been torn down by mucin. It will be noted that the strands of tumor cells are separated by varying amounts of interstitial mucoid matrix which in places forms large masses in which tumor cells have disappeared and that the stroma has here undergone hyaline degeneration. (Case 1)

there was some irregular bone formation in the region of the second and third lumbar vertebrae particularly the lower aspect of the second lumbar.

Operation June 6 1924 A long slightly curved incision was made across the surface of the tumor with the convexity of the curve upward—a segment of the overlying skin being removed subsequently along with the tumor. By careful and laborious dissection the tumor was freed from skin from the levator ani muscle and coccygus and in front with considerable difficulty from the wall of the lower rectum. So closely was it attached to the wall of the rectum that a portion of the latter seemed to be endangered. Above it was not found possible to separate the tumor cleanly from the coccyx or lower end of the sacrum which had to be cut across with bone forceps. Coccyx was almost entirely destroyed and tip of the sacrum was taken away with the tumor mass. After removal of the tumor the lower rectum bulged into the space left and it had to be supported by plastic suture of levator ani muscles and fascia so as to endeavor to form a secure pelvic floor. The wound was closed in layers provision being made for drainage.

Immediate after course In spite of the somewhat extensive operation and the large wound which could be closed only in part healing took place practically *per primam*. There was very little difficulty with the bladder or bowels and the patient was dismissed from hospital a month after operation apparently well. There was no sign of tumor and except for a subjective sensation of weakness in expulsive power at defecation due to the weakened pelvic floor the man seemed little the worse for what had been done.

Later course The man reported himself at intervals during the following years up to January 5 1927 during which period—two and a half years—there was no sign of recurrence. At each visit the man looked well and expressed himself as feeling well. From January 1927 until April 1928 he failed to report but on the second of these dates he presented himself again with unmistakable evidence

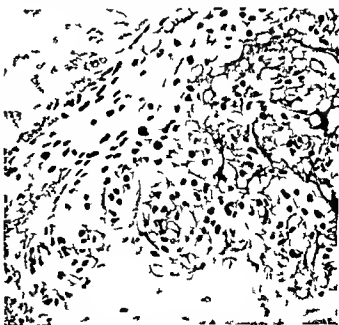


Fig. 7 High power photomicrograph showing highly vacuolated tumor cells with a moderate amount of intercellular matrix. (Case 1)



of the pelvis and its close relation to the lower rectum as well as its apparent continuity with the lower sacrum this operation was difficult and laborious.

The superficial part of the tumor was first of all cleared from the overlying skin a part of the old scar being removed with the tumor. The deeper part of the tumor had to be separated very carefully from the rectal wall but this was successfully accomplished without opening into the lumen of the bowel or apparently damaging its wall. At the upper part of the tumor it was found to be continuous with the sacrum which was invaded by tumor growth. An endeavor was made to get beyond the growth by removal with it of a further portion of the sacrum but in the process the tumor was unavoidably opened into. Very thorough scraping away of the invading tumor tissue and of the obviously invaded bone was carried out but it could not be said with confidence that complete removal was satisfactorily effected. Accordingly after the pelvic floor had been reconstituted and the wound had been for the most part closed the area under suspicion was surrounded by a barrage of radium introduced in a ring of tubes which enclosed the lower segment of the remaining sacrum. These radium tubes were left *in situ* for 36 hours.

After course. The immediate healing of the wound was uneventful as before though probably as the result of the radium the extreme upper end of the wound was a little slow in closing. There was never however more than a little thin serous discharge. The parts ultimately cicatrized firmly and the man was dismissed from hospital on July 7, 1916, six weeks after the operation with the wound completely healed. He seemed well and was free from pain. His only discomfort was a feeling of futility or ineffectiveness when he strained in the effort to pass urine or to defecate. This was due to the inevitable weakening of the pelvic floor as the result of the two operations. By the use of simple laxatives however quite good evacuations of the bowels could be obtained without much trouble. So far as urination was concerned the man had gradually acquired with practice fair facility in emptying his bladder by the avoidance of any effort at straining. It is too soon yet to attempt to form an opinion as to the further prognosis in the case. Examined before his dismissal from hospital no sign could be made out of any fresh growth either externally or palpable from the rectum.

Pathology of the tumor. Sections both of the primary tumor and of the recurrent tumor were found to conform generally with the histological characters of a typical chordoma to which reference will be made later. Particularly it was found that the tendency of the cells of the alveolar masses to mucoid degeneration was well marked abundance of mucin droplets being present both intracellularly and between the cells.

There was extensive hyaline degeneration of the supporting fibrous stroma and areas of hemorrhage

were present throughout the tumor in considerable number. Many of these areas were of some size especially in the center of the larger lobules. The photograph of the patient and the water color drawing of a mesial section of the primary tumor (Figs 3 insert and 4) illustrate very well both the areas of hemorrhage and the degenerated stroma.

Histology (Dr Cappell). We are indebted to Dr D. I. Cappell for the following detailed description of the histological findings both in the primary tumor and in the material from the second operation. Dr Cappell's report is embodied herewith (Figs 6 and 7).

Primary Tumor. The tumor exhibits a frankly alveolar structure with widespread mucoid degeneration of the cells. The growth is surrounded by a dense fibrous tissue capsule which in many places is in a condition of hyaline degeneration.

The stroma which separates the alveoli of tumor cells carries fairly numerous blood vessels often with rather thin walls so that hemorrhage into the degenerate parts of the tumor is common. Numerous lymphocytes and phagocytes containing altered blood pigment are present in the stroma which is often very hyaline.

The tumor cells are best preserved at the alveolar margins but are found to exhibit extreme polymorphism in different parts of the growth. There are areas of small polygonal cells with rather empty cytoplasm and round or oval nuclei.

At an early stage these cells begin to produce a mucinous secretion which at first accumulates within the cells producing a vacuolated appearance. This secretion is generally poured out into the intercellular spaces and leads to the characteristic separation of the tumor cells into irregular trabeculae which tend to assume an irregularly radiate arrangement. The mucoid secretion accumulates toward the center of the nodule of tumor cells and leads eventually to the formation of large masses of mucoid material in which the surviving cells are situated only at the periphery. Into such masses hemorrhage often occurs. The secretion does not always escape readily from the cells but accumulates within the cytoplasm producing large vacuolated cells—the so called physaliphorous cells. Many of these cells exhibit nuclear hyperchromatism and in places multinucleated syncytial giant cells are formed. The nuclei of the tumor cells are often markedly vacuolated and actual physaliphorous nuclei are readily found.

In the material from the second operation the tumor presents a structure almost identical with that removed previously but irregularity in size and shape of the cells is rather more pronounced and multinucleated syncytial giant cells with hyperchromatic nuclei are more abundant.

The stroma in the more recent material is often overrun with polymorphonuclears but this is probably attributable to the influence of necrosis and degeneration.

CASE OF CHORDOMA OF THE DORSAL SPINE

A D. male aged 55 years was admitted to the Western Infirmary Glasgow on September 1 1927 under the care of Dr R. Barclay Ness. His complaint was of loss of power in the lower limbs which had developed gradually during the 9 months immediately preceding.

History. The first symptom observed was that the legs got easily tired the right being more affected than the left from the very beginning. Soon after the onset there was found to be some difficulty in coordination. He staggered and swayed in walking. Along with the development of this incoordination he had pain and a sense of constriction around the lower part of the chest. This however had largely passed off before his admission to hospital. For 3 weeks before his admission patient had been confined to bed almost altogether. When occasionally he did get up he had the sensation of walking on velvet. Subjectively he felt his legs and feet cold and numb from the knees down. His previous health had been good and his family history presented no point of special interest.

Summary of condition while under investigation in medical ward. The patient was a fairly well developed man of rather spare habit. He had a slight degree of scoliosis to the right in the lower thoracic region. There was no evidence of impaired function of the cranial nerves or of any of the nerves of the upper limbs. The abdominal reflexes were absent. There was at first no incontinence of bladder or bowels but there was some delay in micturition. Later there was for a considerable period definite lack of control of the bladder (which continued for a time even after his operation). There was no pain in the lower limbs during his residence in hospital.

Loss of power in the lower limbs was very marked especially in the right. It involved the whole limb from the hip downward. He was quite unable to stand alone. There was no tremor and at first the knee and ankle jerks were not exaggerated. Later they became much exaggerated. There was a positive Babinski sign on both sides from the time of admission and ankle clonus could be elicited on the left side but not on the right.

Subjectively both legs and feet felt numb and there was defective sensibility for temperature and touch reaching as high as the nipple line on both sides. The muscle joint sense was unimpaired.

The Wassermann test both blood and cerebrospinal fluid was negative and lumbar puncture yielded at first a clear cerebrospinal fluid of normal character at a pressure of 100 millimeters of water. The pressure response was normal but there was a slight increase on coughing.

A ray examination of the spine revealed a definite abnormality of the fifth and sixth dorsal vertebrae the intervening disc being apparently destroyed and merged in an ill defined mass which involved both the contiguous vertebral bodies. The discs above and below these vertebrae were thinned

in the progress while in medical ward. During the 3 months he remained in the medical ward his condition got steadily worse. Spasm of the lower limbs became a very marked and distressing feature. Bed sores formed over the sacrum over the trochanters and elsewhere on the slightest provocation. These sores healed only with great difficulty and very slowly. They readily broke down again. A later examination of the cerebrospinal fluid gave evidence of definite spinal block.

Transferred to a surgical ward on December 14 1927 with a diagnosis of compression paraplegia due to tumor growth the man's condition had become much worse. Bladder and bowel control were largely lost and spasm of the lower limbs was a very marked feature of the condition. Spasmodic flexion and contracture were well developed and the spasm of the adductors of the thighs was particularly pronounced. The sores over the sacrum and trochanters were barely healed and broke down afresh very readily.

Operation December 7 1927. The operation was carried out without any general anæsthetic novocain anæsthesia being employed. The surface tissues for some little way above the region of operation were first of all infiltrated and thereafter the nerve roots for several segments above were blocked. The result was satisfactory the man experiencing no pain during the operation.

The spinal column was exposed in the usual manner and the spinous processes and laminae were removed from the third to the sixth dorsal vertebrae inclusive. The cord was found compressed and flattened to the left anterior aspect of the spinal canal by a tumor entirely extrathecal involving the bodies of the fourth fifth and sixth dorsal vertebrae. At this level the cord showed no pulsation. The tumor was of a soft crumbling character. It seemed to have originated from the bodies of the vertebrae and to have spread into and partially destroyed the corresponding laminae.

As much as possible of the tumor was removed and the cord relieved of pressure began to pulsate again. Complete removal of the tumor seemed to be impracticable by reason of the extent and nature of the involvement of the vertebral bodies. It was recognized that the operation could probably only be of the nature of a decompression procedure. The wound was accordingly closed some what loosely in layers a drainage tube being inserted at the lower end of the wound and so fixed there that its deep end reached just down to the upper margin of the bony canal.

Immediate after course. The operation was well borne and the wound healed *per primam*. The drainage tube proved to be hardly necessary and was removed early.

The first notable result of the operation was the recovery of bladder and bowel control within a few days. Very soon too the recurring spasms of the lower limbs became less troublesome but for a considerable time there was little difference otherwise.

in the lower limbs either as regards sensibility or in respect of power. The tendency to bed sore for a long time continued to be a troublesome feature for some time and indeed for a good many weeks doubt was felt as to whether the man was not going to get steadily worse and die. Ultimately however a definite improvement in his general condition took place and it was possible to get him out of bed for a time each day. From this point he improved more rapidly and he was dismissed from hospital on April 13, 1928, i.e. 3 1/2 months after his operation.

Later course. This patient reported himself for examination 6 months after his operation when his general condition was found to be very good. He still had a definite but much less marked contracture of the hamstring group of muscles in both thighs and there was slight adductor spasm but the spastic condition of the limbs generally and more especially of the legs (below the knees) was very much improved. The man could get about comfortably in a bath chair and was able to assist himself from bed to chair or from chair to bed standing on his feet and steadying himself by his arms. He was able to take interest in his garden and he expressed himself as feeling well pleased with the result of his operation. He had occasional difficulty with micturition and a tendency to constipation but there was no incontinence either of bladder or of bowel. In spite of his persisting disability the man was surprisingly cheerful.

Pathology of the tumor. For the following description of the histological characters of the tumor we are indebted to Dr D. F. Cappell.

Microscopically the tumor is composed of a very abundant matrix and fairly numerous cells which show a tendency to irregular nodular formation. There is rather abundant hemorrhage in places in the mucoid matrix. Around each cell the matrix appears to be condensed and the cells are slightly shrunken thus presenting an appearance closely resembling cartilage (Fig. 8).

The tumor cells tend to be scattered irregularly throughout the matrix and do not exhibit the characteristic arrangement of chordoma cells which generally form long strands with a tendency to a radial arrangement in the nodules the center of which is often purely mucoid. The tumor cells are generally round or oval with a deeply staining nucleus a well defined nuclear structure and a single nucleolus and present all gradations from small cells with deeply staining cell bodies to large vacuolated masses of protoplasm the typical physaliphorous cells (Fig. 10). Nuclear vacuolation is not easily seen but can be found on careful search.

The inter cellular matrix is unusually abundant and gives the characteristic staining reaction for mucin with polychrome methylene blue and mucicarmine (Fig. 9).

The stroma is exceedingly scanty in the fragments examined and the usual enveloping capsule of the growth has not been found but this is prob-

ably attributable to the paucity of the material at disposal. The stroma consists of little more than capillary vessels with thin walls poorly supported by connective tissue fibrils (Fig. 8). Around some of the larger and thicker walled vessels there are areas of hyaline material which may represent altered mucoid matrix as it stains more bluish with the polychrome stain and reddish with van Gieson. Around the groups of cells which form the poorly defined nodules previously described the condensed matrix stains reddish with van Gieson and presents a vague fibrillar structure this supports Peyron's idea that transitions between chordomatous secretions and collagen occur.

The tumor cells are somewhat more numerous in relation to the fibrous septa and here they present an aspect more typical of chordomatous growths forming irregular strands which soon become lost in the abundant matrix. Even here however the cells exhibit the tendency to dissociation from one another which has been previously described. Fragments of bone from the laminae of the vertebrae were also examined after decalcification but only scanty traces of invasion by tumor cells were found.

It will be observed that Dr. Cappell when he wrote the above description was not so confident as he has since become of the diagnosis of chordoma in this case. We have since discussed the case and the appearances with him and we have little doubt that he has rightly come to the conclusion that the tumor in this case must be classed as a chordoma.

It should be stated also that the sections have since been submitted to Professor Matthew J. Stewart (Leeds) who is definitely of opinion that the tumor is undoubtedly of chordomatous type.

The type of tumor with which alone it might have been confused was a chondroma undergoing degeneration and it is true that certain features referred to in the above report at first suggested such a diagnosis to Dr. Cappell but a more comprehensive view of the appearances would seem to negative such a diagnosis. Dr. Cappell draws attention also to the fact that chondromata of the vertebral column are themselves exceedingly rare.

If the opinion of the surgeons who have seen the actual growth at operation and have been able to observe the naked eye characters of the tumor its consistence its vascularity etc. is of value in this connection we would hazard the opinion very definitely

for what it is worth that the tumor had little or nothing in appearance in common with a chondroma and we believe therefore that Dr Cappell's diagnosis of chordoma on the basis of the histological findings may be accepted with confidence

HISTORICAL RESUMÉ

The development of our knowledge of tumors of notochordal origin has taken place within the last 30 years and more particularly since 1912 when Professor Matthew J Stewart of Leeds reported the first case recognized in Britain. In *The Journal of Pathology and Bacteriology*, vol xxv, 1922 he gave a full account of the case and also added an excellent historical summary of cases recorded in the literature up to that time.

From that time further cases have been reported in Britain and elsewhere with considerable frequency so that 4 years later in a further paper already referred to Stewart and Morin were able to record a total number of 57 cases. Dr D F Cappell in his paper also previously referred to to be published in the middle of October in *The Journal of Pathology and Bacteriology* brings the number of recorded cases including the three vertebral cases with which his paper specially deals to a total of 80. This number of course includes the two referred to in our paper.

Professor Stewart's first case was that of a man aged 65 years who was operated on by Sir Berkeley Moynihan in May 1910. The case is of particular interest in view of its resemblance to our first case. The man had a tumor in the sacrococcygeal region which had been growing slowly for 8 years. In general outline it was hemispherical measuring 3 inches each way. Moynihan seems to have removed it without any special difficulty.

The tumor was examined by Professor Stewart at the time and the opinion was expressed that it was a peculiar type of carcinoma undergoing widespread colloid degeneration. It seemed to be well encapsuled. Its true nature was not then appreciated.

Some 9 years later however as Stewart states in his original paper he was led to review the case afresh as the result of being

shown sections of a chordoma by Professor Peyron of Marseilles. These sections evidently recalled to Professor Stewart's memory certain similar appearances in the tumor in question which he had examined 9 years before.

The patient was accordingly sought out and was visited in September 1920 i.e. 10 years and 4 months after operation and was found to be still alive. He was apparently in fairly good general health but he had both a local recurrence and secondary deposit. These were (1) a small nodule about the size of a pea in the middle of the old sacrococcygeal scar (2) a large sausage shaped mass in the region of the left buttock running downward and outward and measuring 12 inches by 3½ inches (3) a mass 8 inches by 4 inches in the upper dorsal region over the right scapula.

The mass in the left buttock had appeared 5 or 6 years after his operation and the tumor in the right scapular region 3 years later. The small local recurrence had not been noticed previously. Pain was complained of along the course of the left great sciatic nerve and the tumors caused considerable discomfort by reason of their size. Six months later a further tumor appeared in connection with the upper end of the left femur. The man died in June 1921 at the age of 76 years.

It will be observed that in this case a tumor was known to have been present for 8 years before it came to operation and that the man lived for 11 years afterward a total duration therefore of 19 years.

This illustrates very well the frequently very slow growth of tumors of this type which though they may be large and generally are definitely malignant in character do not as a rule lead to an early fatal issue either from their direct local effect or from metastases.

In the first of our two cases the first size of the tumor was observed in 1920 so that the duration is up to the present fully 8 years.

In his original paper Professor Stewart gave an excellent historical summary of recorded observations up to that time. He

dealt with 6 cases of tumors believed to be of notochordal origin—15 at the clivus Blumenbachii (dorsum sellæ) and 9 in the sacro coccygeal region. The following short outline is taken from his paper:

Luschka in 1856 described a soft lobulated jelly like mass protruding into the skull from the clivus and perforating the dura mater. Virchow in 1857 gave what was perhaps the first good description of the condition. He evidently thought that he was dealing with formations of a cartilaginous nature whose fundamental substance had undergone softening and whose parenchyma cells showed vesicular degeneration. He therefore applied the term *ecchondrosis physaliphora* to the condition. The site of origin was in the neighborhood of the sphenoparietal synchondrosis.

H. Mueller in 1858 was the first to suggest that these tumors were of notochordal origin. He demonstrated rests of notochordal tissue in the basilar cartilage of man and animals and showed that in the fetus the notochord reaches up to the sella turcica. In the sphenoparietal synchondrosis it remains as a small soft mass analogous to the nuclei pulposi of the intervertebral discs which are generally recognized as relics of chordal tissue. Mueller also showed that in the region of the future sphenoparietal synchondrosis the notochord has a decided tendency to approach the superior surface of the basilar cartilage.

It seems that Ribbert who confirmed the observations of Mueller in 1894 was the first to suggest the name *chordoma*.

The first recorded cases of sacro coccygeal chordoma of definite clinical interest in man seem to have been those of Feldmann and Mazzia in 1910.

NOMENCLATURE

Stewart suggested that the small jelly like nodule having very limited powers of growth which is met with occasionally arising from the middle of the clivus should be termed *ecchondrosis physaliphora sphenoparietalis*. This type of tumor seldom gives rise to any large progressive formation and is met with usually only as a casual finding in the post mortem room. It may be regarded rather as

a simple notochordal protrusion than as a tumor.

Other less frequent tumors in the same situation having greater powers of growth and capable of producing definite symptoms and even of leading to death must be regarded as genuine neoplasms. To a tumor of this type Stewart would apply the term malignant sphenoparietal chordoma.

For similar tumors springing from or related to the posterior extremity of the notochord and of the spinal column he suggested the term malignant sacro coccygeal chordoma.

Cappell now records three examples of a malignant chordoma springing from other regions of the spine: two from the cervical region and one (our second case) from the dorsal region. In his paper Cappell refers also to a limited number of recent observations of the condition in other situations.

NAKED EYE CHARACTERS AND HISTOLOGY OF CHORDOMA

The description given by Stewart of the naked eye characters of the tumor in his first case and of its histology is so complete and corresponds so closely with what may be regarded as the typical findings in such tumors that we venture to summarize his description here.

NAKED EYE CHARACTERS (STEWART)

The tumor is well encapsuled and is of rounded or lobulated outline. On section the cut surface presents a lobulated appearance with dense fibrous tissue of varying width separating the lobules. The latter show mucoid degeneration often of a very advanced character and the stroma in those regions is often the seat of marked hyaline degeneration. The appearance presented may suggest very strongly that of a colloid carcinoma. Where the mucoid change is less advanced the tumor tissue may be firm granular and opaque like a fairly cellular carcinoma. Hemorrhages both old and recent and varying in size are present as a rule here and there through the substance. Such appearances on the cut surface of a tumor of this kind are well illustrated in photograph and water color drawing from our first case (Figs. 3 and 4).

HISTOLOGY (STEWART)

The tumor is alveolar in structure and shows a clean cut separation through the parenchyma and stroma the whole encapsuled by a layer of dense fibrous tissue. The alveolar masses vary greatly in size and while many of them especially the larger show advanced mucoid degeneration others especially some of the smaller are richly cellular. The stroma is in the form of strands of fibrous tissue of varying width much of it showing hyaline degeneration.

Parenchyma There are all gradations from active cellular tissue to areas of extreme mucoid change. The cells in the former are distinctly epithelial set close together often without intercellular substance while in the latter they are broken up into little masses in the midst of the mucoid material. Cellular outlines are often indistinct so that at first sight the mass may suggest a multinucleated syncytium filled with vacuoles and collections of mucoid material. In the youngest most active looking areas the cell margins are more clearly made out the shape of the cells being irregularly polygonal. There is great variation in size the larger cells occurring chiefly in the richly cellular areas. In regions where mucoid degeneration is advanced the cells are mostly small and shrunken and stain deeply.

The mucoid degeneration which is one of the most striking features of the tumor seems to begin at an early stage in the life history of the cell. At first the droplets of the mucin are small and *intracellular* but they soon enlarge and lead to a high degree of cytoplasmic vacuolation. The mucin escapes and collects intercellularly. The collections of mucin ultimately break up the tumor tissue first into cords then into little groups of shrunken tumor cells the whole appearance suggesting the character of the degenerating notochord in the nuclei pulposi of the intervertebral discs. Occasionally a cell is ballooned out by a large amount of mucin as if the cell possessed an unusually strong cell membrane or a specially condensed peripheral zone of cytoplasm. This is the fully developed physaliphorous cell of Virchow.

The nuclei of the tumor cells show great variation in size and considerable variation in

shape. The majority are oval or spheroidal 10 to 15 μ in diameter. Others are polymorphous while in the most degenerate parts of the growth they may be shrunken crenated and very irregular in outline. Nuclear staining varies in intensity. Large round hyperchromatic nuclei 20 to 35 μ in diameter are fairly frequent chiefly in the more cellular less degenerate parts of the tumor where also multinucleated cells may be found. Each nucleus contains one or two and sometimes three nucleoli. Mitotic figures are few in number.

Widespread nuclear vacuolation is a striking feature. The vacuoles vary in size and number. Single vacuoles may attain a large size as much as 20 to 50 μ and may lead to extreme distention of the nucleus. There are generally several vacuoles and there may be as many as 6 or 8 in a single nucleus. Occasionally a cell has been met with in which the nucleus was ballooned out by a single large vacuole filled with numerous droplets—an actual physaliphorous nucleus. Nuclear vacuolation is most frequent in the more cellular parts and it is absent where mucoid degeneration is advanced.

The stroma is composed of fibrous tissue which in places shows advanced hyaline degeneration. Here and there are areas of extensive lymphocyte and plasma cell infiltration with varying numbers of polymorphous eosinophils and mast cells. Blood vessels are fairly numerous and small recent hemorrhages are frequent. Some of the areas of hemorrhage are of larger size the blood having broken through into the interior of the alveoli. Former hemorrhages are indicated by collections of endothelial cells filled with yellowish brown pigment.

The hyaline change is best seen in those portions of the tumor in which mucoid degeneration of the parenchyma is advanced.

At the periphery the tumor is enclosed by a dense fibrous capsule of varying thickness. Elastic fibers are present only in the outer layers of the capsule not in the walls of the alveoli or elsewhere throughout the tumor.

In Stewart's case there was no evidence of invasion of the vessels by the growth as has been described by some observers.

The following are Professor Stewart's general conclusions and except that a wider observation has shown that similar tumors may occur in sites additional to those specified by him in his original paper it may be said that these conclusions are now pretty generally accepted. We quote them here in full.

1 'Chordoma is a tumor arising from relics of the notochord and is met with chiefly in the neighborhood of the spheno occipital synchondrosis and in the sacrococcygeal region.

2 Both simple and malignant forms occur the latter being much the more common. Even the malignant varieties are usually of slow growth and long continued course especially those occurring in the sacro coccygeal region. They tend to recur after removal and cause death chiefly by their local effect dissemination being quite exceptional.

3 Intraosseous tumors by virtue of their position are much more serious than sacro coccygeal their average duration from the first onset of symptoms being about two years as compared with nine years in the latter group.

4 The histological characters are distinctive. The tumor is alveolar in structure and the parenchyma usually of epithelial type is composed of cells which become the seat of mucoid degeneration at a very early stage of their development. The mucoid change ultimately progresses to an extreme degree and is comparable to that seen in the nucleus pulposus of an intervertebral disc. In malignant cases the nuclei show great variation in size and in depth of staining and nuclear vacuolation may be present.

THE NOTOCHORDAL ORIGIN OF CHORDOMATA

The developmental relation between these tumors and the notochord has gained in recent years an increasing degree of support both on embryological grounds and by reason of the remarkable resemblances between the histological characters of the tumors and

those of the notochord, or of such chordal rests as exist in the nuclei pulposi.

In his most recent paper on 'Chordoma of the Vertebral Column' Cappell has an interesting note on the development of the notochord in certain of the lowest vertebrate forms and on some aberrations of this development which have been observed by different workers. He describes also and illustrates, the resemblances between the histological features in one of his cervical cases and the appearances characteristic of the developing notochord in *Lepidosiren*.

He points out that the notochord at an early stage of its development consists of a solid rod of epithelial cells extending from infundibulum to cauda in the embryo. In the cytoplasm fluid vacuoles accumulate until the cell body becomes turgid; this fluid inflation of the cell elements of the primitive skeleton being responsible for supplying the firmness necessary for its function of support.

He describes how the notochord is surrounded by a double sheath the outer portion which he terms the *primary sheath* consisting of flattened cells of as yet undetermined origin (doubtfully notochordal or mesoblastic) and within this a *secondary sheath* formed by a mucoid material which he believes to be secreted from the more superficially placed cells of the notochord. This secondary sheath forms a layer of fairly uniform thickness around the central notochordal cells. The more central cells retain their secretion within their cytoplasm and become in consequence distended enormously by globules of doubtful nature.

Cappell has found that these appearances in the different stages of the ontogeny of the notochord are reproduced with striking fidelity in the histological characters of one of his cervical cases. To quote from his paper

There are (in some places) solid areas of clearly demarcated epithelial cells such as are found in the notochord in the second stage of its development. Later the cells begin to differentiate the characteristic mucinous secretion of notochordal cells appears and actual physaliphorous cells are formed. In other places the secretion is poured out freely into the intercellular spaces the cells become shrunken and the appearance of the notochord at a more advanced stage of development is reproduced

Th b ly f t th M lg t Spb p-Occ p l Ch
d m and t t th E h d f Ph y l ph Sph o-Occ p t l

in an exaggerated degree. Lastly, just as when the notochord becomes enclosed in the centers of the intervertebral discs to form the nuclei pulposi, the cells of the tumor become modified to form irregular syncytial strands with many large vacuoles of unknown nature.

As Cappell says

The presence of very definite sheaths round the smallest elements of the tumor is a striking example of the reversion of tumor cells to a stage far back, not only in the ontogeny of the individual but also in the phylogeny of the vertebrates.

Cappell figures a number of these appearances in a series of photomicrographs and a critical examination of his illustrations constrain one to admit that they go far to support the view that the histological resemblances of the minute histology of the particular tumor under consideration to the histology of the developing notochord furnish strong presumptive evidence of a developmental relation between the two.

Cappell has a further interesting note regarding the manner in which chordal tissue may develop into tumor formation. He is clear that in his two cervical cases the tumor has originated in the affected vertebral body, or on its anterior or posterior aspect rather than in notochordal cells persisting in the intervertebral discs. In this connection he recalls the fact that the anterior end of the notochord in man instead of being uniformly enclosed within the basal skull cartilage is in part infrabasal so that it lies immediately above the epithelial roof of the pharynx re-entering the basal skull cartilage in front of this point. This infrabasal part disappears earlier than the other portions of the notochord and is present usually only between the 1 millimeter and the 18 millimeter stages of the embryo. That such a relationship of

notochord to basal cartilages and pharynx is recognized as normal is borne out by the fact as Cappell points out that it is figured in standard works on embryology. He believes that the establishment of such connections affords ground for suggesting a possible origin for cases such as his first cervical one.

Developmental abnormalities at lower levels have been recorded by different writers. Cappell cites some of these observations such as those of Peyron, Dunet, Linck, and Warstadt showing the existence of chordal rests beneath the perichondrium of the sacral bones on the anterior or posterior surfaces of these—in the mesenchyme as small protrusions in the lumbar bodies of human fetuses as fine connecting strands between the successive nuclei pulposi passing through the intervening vertebral bodies and even in the form of small branches from these connecting strands passing toward the anterior or posterior aspects of the vertebral bodies.

Finally, Cappell has found in the lumbar region of a 1 millimeter embryo small strands of notochordal cells issuing from the central core connecting the notochordal masses in the intervertebral discs and passing ventrally, laterally, and even dorsally. He has not been able, however, to demonstrate that they led to any foci of chordal tissue on the exterior of the vertebrae. He figures a section of a lumbar vertebra showing a protrusion of the sheath and cells of the central notochord passing laterally to become lost gradually among the cells of the developing cartilage and he suggests that such observations support the view that there exists normally in this central thread of chordal tissue perforating or channeling all the vertebral bodies a sufficient basis from which notochordal tumors in the vertebral bodies may arise.

VENOUS DILATATIONS AND OTHER INTRASPINAL VESSEL ALTERATIONS, INCLUDING TRUE ANGIOMATA, WITH SIGNS AND SYMPTOMS OF CORD COMPRESSION

A REPORT OF FOUR CASES WITH A REVIEW OF THE LITERATURE¹

J. H. GLOBUS, M.D., NEW YORK

AND
I. J. DOSHAY, M.D., NEW YORK

THERE is a small group of alterations and malformations of spinal cord vessels which give rise to signs and symptoms of spinal cord compression. This group includes the localized dilatations or aneurismal formations of spinal cord vessels and the true hemangioma which are with rare exception recognized only on the operating table or at postmortem examination. They are more often diagnosed as spinal cord tumors since their clinical manifestations by virtue of their focalizing character are not unlike those found in spinal cord compression. Before the advent of manometric tracings and intraspinal lipiodolography such errors in diagnosis were obviously unavoidable since there were as yet no reliable diagnostic features for the correct identification of the vascular origin of such tumor like structures and since they provoked symptoms such as noted in various forms of intraspinal neoplasm.

It was in search of some helpful pathognomonic signs in such vascular lesions that this study was undertaken. The study was concerned mainly with the focal dilatations of spinal cord veins and included an analysis of the clinical manifestations and anatomical findings in a large series of cases collected from the literature and an account of our own cases. However while our own material is well as the majority of that recorded in the literature belongs to the group in which the vessel changes are in the nature of venous dilatations we nevertheless have extended this survey to include all examples of tumor like vascular alteration neoplastic or non neoplastic in character. Thus we have added to the rather large assembly of various types of allied conditions such as arterial and arteriovenous aneurisms which differ from the former group

mainly in their anatomical features and the true hemangioma with which the former two groups are often confused. These will be discussed separately and for convenience of description under the following headings: Group I venous dilatations; Group II arterial or arteriovenous aneurisms; Group III hemangioma—(a) intramedullary, (b) extramedullary (pia), (c) extradural and (d) vertebral.

GROUP I—DILATATIONS OF SPINAL VEINS

This is the largest group assembled. The individual members present anatomical variations which are responsible for a corresponding assortment of terms under which they are described. Thus we have a series of names such as pial hemorrhoids (Gaupp), circoid aneurisms of the spinal veins (Raymond and Cestan), varicose dilatations of spinal veins (Jument and Valensi), angioma venosum racemosum (Krause) and angiomata all of which however can justifiably be grouped together under the single term of dilatations (varicose) of the spinal veins.

The occurrence of this form of spinal vessel alteration is considered rare by almost every one who has written on this subject. However no such conclusion can be drawn from the meager material available in the literature. The scarcity of material is in great measure due to a lack of opportunity for post mortem examination of well studied neurologic material and above all to the indifference of the pathologist to the examination of the intraspinal contents in non neurologic cases. To obtain some conception as to the frequency with which dilatations tortuosities and other anomalies of pial veins of the spinal cord occur we must turn mainly to the work

of Kady. In a general study of the vascular supply in a series of 26 cases of human spinal cords he found that dilatations and tortuosities of larger or smaller veins of the spinal cord are not uncommon. In 8 patients various degrees and several types of varices of the spinal cord veins were noted. Even in spinal cord in which the veins presented a normal appearance he frequently noticed that the course of the veins on the dorsal aspect of the cord was somewhat tortuous. He therefore concluded that a careful study of a larger series of cases would disclose various transitional forms with gradual change from the normal condition to the most marked grade of varicosities in which the venous trunks and their branches form a most bizarre network and are often so extensive as to cover the surfaces of the spinal cord completely. He also described changes in the pia arachnoid membranes directly over the varices. The membranes were thickened and had the appearance of an old inflammatory lesion. This led him to assume that at least in some instances an inflammatory process might be responsible for the development of varicosities of the spinal veins. Unfortunately he was unable to give any clinical data in the individual cases studied and could throw no light on the character of his material beyond the fact that the varicosities of the veins of the spinal cord were found only in cases in the far advanced years of life. He also suggested the possibility that excessive muscular activity, particularly of the spinal muscles, caused an obstruction to the free circulation in the spinal canal and was an important contributing factor in the production of varices on the surface of the spinal cord.

Kady described two types of varices. In one series of cases he found on the dorsal surface of the cord large tortuous veins which resembled in their arrangement loop of small intestines. The vessels covered the spinal cord in several layers, the smaller branches showing very little of this tortuosity and varicosity. Such a picture in his opinion could be explained only by an interference with the free return of venous blood from the spinal canal, the obstruction being very likely caused by excessive contraction of the muscles of the spinal column. In another group the smaller

vessels showed a high grade of tortuosity and formed veritable pools while the larger venous trunks were not enlarged and appeared narrowed in contrast with the dilated smaller branches. In such instances he found a distinct interruption between the ventral and dorsal venous anastomoses.

It occurred to him that the narrowing (and possibly complete obliteration) of the larger trunks caused the formation of a collateral circulation in the smaller venous channel with the result that the latter because of the new burden became widened, elongated and tortuous. In some instances he noted that root veins as large as the main trunks became in some part of their course very narrow or completely obliterated. In these cases he believed that the dilatation of the smaller branches was compensatory.

In a more recent analysis of the various views held as to the causative factors in the formations of phlebectasias, varicosities and so called venous angiomas, Benda does not give definite conclusions. He quotes Rokitsky, who stresses the mechanical hindrance to the blood flow as the all important factor. Rokitsky enumerated a number of anatomical alterations which may bring about such an interference in circulation. Among them are pressure upon a venous trunk by a tumor, obliteration of venous channels, unusual posture of the body causing a slowing down of the return blood flow, oft repeated attacks of hyperemias or inflammations in an organ and finally inflammation of the veins themselves. But he also recognized that the purely mechanical factors did not explain all the phenomena observed in such venous dilatations. Some concomitant or pre-existing alteration in the involved veins must be considered as an important additional factor. Degenerative, sclerotic or inflammatory change are considered by many as the probable predisposing condition which when acted upon by a local or general circulatory disturbance determines the focal and somewhat circumscribed venous dilatations. The possibility of a pre-existing congenital weakness in the vessel wall as a contributory factor is dismissed by Benda as a conception unwarranted by known facts. Thus the present opinion does not vary greatly

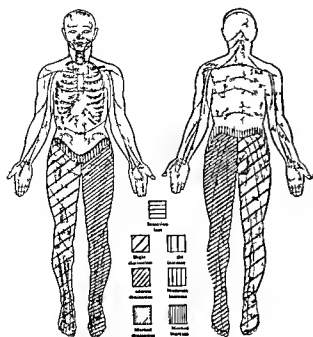


Fig. 1 Sensory chart indicating changes in pain and temperature sense Case 1

from the older views expressed by Kady, but it does coincide with the view held by Rokitsky that by impairing normal return of venous blood abnormal postures have an important bearing on venous dilatations.

Benda makes another valuable contribution to the subject of venous dilatation by offering a simple classification of such anomalous conditions. His classification brings order into the somewhat confusing terminology and above all makes the interrelationship between the several varieties more obvious. He reduces the large assortment of venous anomalous dilatations to three forms:

1. *The phlebectasias* which he describes as a form of diffuse widening of the lumen of the veins in which the shape of the dilated veins depends upon the type of vessels involved. The widening of a large trunk will result in the cylindrical variety while widening of small branches gives rise to the so called cirroid or plexiform variety.

2. *The arcosities* a form in which diffuse but irregular dilatations are characterized by circumscribed ampullar or sac-like formations. Usually these are not associated with the first form of venous alteration and may be regarded as a more advanced stage.

3. *The cirous angiomata*. This is a type which is essentially a circumscribed conglom-

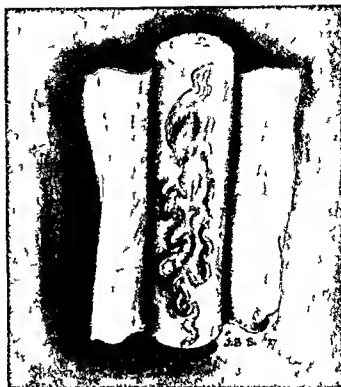


Fig. 2 Drawing showing the appearance of the dorsal surface of the cord Case 1

eration of dilated veins with individual alterations which may fall into either one of the two previous groups: phlebectasias and varicosities. The angiomata differ however from the two other forms by inducing secondary changes such as erosion or production of tissue alterations in the neighboring structures and so acquire the character of tumor formation. Between these three forms however there are no distinct lines of demarcation; they are essentially transition stages of a similar process. A complete or partial closure of a large venous trunk from whatever cause leads to stasis in the blood column with the formation of a collateral circulation and a resulting venous dilatation. In the larger vessels which are adjacent to the obstructed venous stem the dilatation assumes a cylindrical form while dilatation of smaller vessels results in the plexiform or cirroid formation. It is the latter form which is most commonly seen in the pial vessels of the spinal cord. Because of their localized character and because of their mechanical effect upon the spinal cord they may easily fall into the group of the so called venous angiomata. It is quite obvious however that they are



Fig. 3. V. t. fth. d. h. w. g. a. n. m. b. e. f. t. t.
d. d. l. t. d. p. l. Ph. t. m. c. g. ph. > h. m. a.
t. c. y. l. i. n. C. a.

nothing more than circumscribed aggregations of dilated varicose veins and that they are not neoplastic in origin

PERSONAL CASES

CASE. — A C. male aged 50 years well until 7 months prior to his admission to the hospital (April 6, 1906) when one morning he awoke to find himself unable to move his leg. He implored at first but then there was a progressive loss of power in his lower extremities so that he could no longer walk without support. Four months after the onset led to further loss of power in the extremities and developed difficulty in urination, loss of ulnar pulse and a feeling of numbness of the distal surface of his feet.

The patient is unable to walk without both lower extremities markedly paretic, the right more than the left, the right foot drops. The musculature in the affected limbs flabby and atrophied. The right knee jerks both ankles jerk and the arm test is easily can be elicited. The abdominal reflexes are absent. There is a belt of hyperalgesia extending from the fifth dorsal to the second lumbar (Fig. 1). Below the level of the mark of hyperalgesia is the m. h. v. p. a. which is more pronounced on the left. The V. b. t. v. cause m. f. a. d. b. e. l. o. the anterior superior iliac spine. The erysipelas tenderness over the tenth dorsal. The electrical test gives normal responses. The manometer test is normal, with an initial pressure of 90 millimeters, a slight rise on coughing (30 millimeters) and still higher on jugular compression (460 millimeter) and still higher on jugu-

lar compression (500 millimeters). The rises are prompt and are followed by an equally prompt fall in pressure. Serologic and other tests of blood and spinal fluid are negative. The X-ray examination of the spine shows no striking change. The blood pressure in the right arm is 160/90 and in the left 135/75.

While under observation there was no material change in his condition. On May 1906 he was discharged with the provisional diagnosis of extramedullary compression probably due to a neoplasm on the right anterolateral aspect of the cord at the level of the fifth dorsal. He was readmitted on September 30, 1906 complaining of increasing difficulty in urination (he tancy and interruption of the stream) marked constipation, oedema of his left leg and frequent twitching in both lower extremities.

Re-examination at this time showed that added to previous findings the left knee jerk and the lower abdominal reflexes were absent with a loss of touch sense below the first lumbar. The electrical tests of the muscle of the lower limbs revealed a demyelination to farad and an increase of galvanic stimulation. The blood pressure the right arm was 119/76 and in the left 84/56. The monometric tests revealed an initial pressure of 90 millimeter with no material fall on coughing, straining or jugular compression. There was no xanthochromia. The urine showed a faint trace of albumin and few white blood corpuscles, 3 per cent polynuclears, 50 per cent lymphocytes and 7 per cent monocytes. At this time a degenerative process in the spinal cord as concluded as the most probable character.



Fig. 4. S. t. fth. d. l. l. fth. n. m. a.
d. l. t. t. h. 7. m. d. l. t. d. ou.
h. l. Ph. t. m. ph. > 6. h. m. t. y. l. C.

of the lesion though a neoplasm was not entirely excluded.

The patient's incontinence was soon followed by signs of cystitis and pus was found in the urine. His temperature rose to 103 degrees for about 10 days gradually returning to normal. On irrigation of the patient's bladder a fragment of thick mucoid material was recovered which the pathologist reported contained carcinomatous (?) tissue. Immediately the possibility of malignancy with metastasis to the spine was suspected although no primary focus could be found. On November 1 the patient suddenly had a convulsive seizure lost consciousness and appeared to have a right central facial paresis. The fundi showed angiosclerosis and a hemorrhage in the region of the left macula. The patient's condition declined rapidly. He passed into deep coma and died on the fifth day after the cerebral accident without regaining consciousness.

Anatomical findings. Only a small portion of the cord could be removed. It included the lower lumbar and the adjacent sacral segments. On opening the dural sac there was found on the dorsal surface of the cord a fairly circumscribed but very prominent mass of convoluted tortuous pial veins. They were intimately adherent to and apparently invaded the structure of the cord (Fig. 2). A histological study revealed alterations in the pial veins as well as in the vessels and the substance of the spinal cord. The dorsal pial veins showed the most prominent alterations. They were markedly dilated and highly irregular in outline (Fig. 3). This of course corresponds to the tortuosity of the vessels already noted on gross inspection. Some of the veins on the surface of the cord had an oval



FIG. 6 Section of the cord showing hyalinized vessels. Photomicrograph $\times 35$ hematoxylin-eosin. Case 1.

or round form others were flattened or crescentic in outline while still others were sacculated or so malformed as to engulf a neighboring vessel. In addition to this gross variability in size and shape the vessels showed also striking changes in their coats. The media was especially involved. It was hypertrophied and consisted of many cross and oblique connective tissue fibers among which there were seen many smooth muscle fibers. The latter showed many focal quantitative variations often approaching an abundance seen in arteries. The elastic fibers were also quite numerous. The intima also showed mild alterations in the nature of diffused hyalinization. The endothelial lining however was intact consisting most commonly of a single layer of cells but occasionally where the vessel outline was deformed it gave the impression of pseudo stratified structure. The adventitia showed no marked changes there was no mesodermal reaction to suggest an inflammatory lesion.

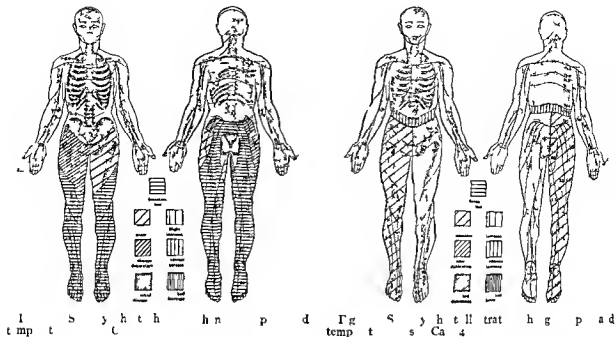
The pial arteries showed no changes aside from a mild hyalinization of the intima.

The leptomeninges were distinctly thickened. There was slight fibrosis and infiltration with macrophages fibroblasts and an occasional lymphocyte.

The substance of the cord showed extensive disorganization in both the white and gray matter. This was due to the marked loss of parenchyma and also to an invasion by numerous distended vessel channels (Fig. 4). Of the gray matter there are left only a few islands of nerve tissue with only a few nerve cells retaining their normal outline and structure. The majority of the residual cells showed disintegration sclerosis and some of them even



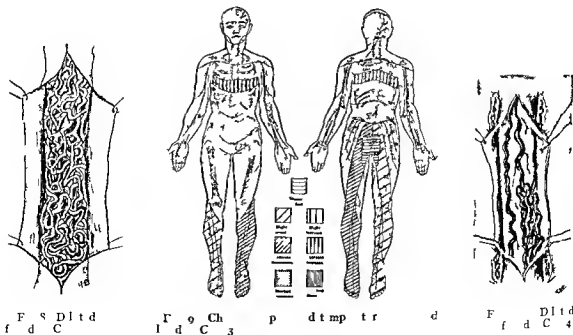
FIG. 5 Section of the cord showing disintegration of its normal cell structure and the increase in glia contents. Photomicrograph $\times 25$ silver carbonate stain. Case 1.



calification and the surrounding by ones of moderate glial hyperplasia in which a t oocyte formed the dominating element (Fig 5). The white matter was the rest of moderate gliosis and only a few islands of partially preserved myelin fibers remained.

Because of the loss of pia mater the vessel in the substance of the spinal cord stood out very

prominently. There were many dilated and deformed venous channels and dilated and the wise altered capillaries and small sized arteries were quite numerous. Some of the veins particularly at the periphery of the cord showed open communication or fusion with the pia mater on the surface of the cord. Similarly groups of intercommunicating or fused blood channels with hyalinization in their



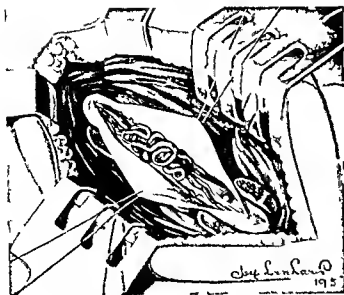


Fig. 12 Drawing illustrating an arteriovenous aneurism of the spinal cord (Elsberg case)

walls were seen within the substance of the cord. They were frequently surrounded by zones of fibrosis. The walls of the arteries showed still more advanced degenerative changes (Fig. 6). There were frequently groups of four to six vessels surrounded by an area of fibrosis having the appearance of a vascular island.

The anatomical findings briefly restated were: (1) marked varicose dilatation of the dorsal spinal veins; (2) extension of this venous dilatation into the vessels of the spinal cord; (3) degenerative changes in the arteries and veins of the nature of moderate arteriosclerosis and phlebosclerosis; (4) marked disorganization and disintegration of the spinal cord substance.

Several clinical features assume greater significance after the pathological process is clear. The rather sudden onset, the progressive course and the terminal cerebral manifestations associated with convulsive seizures are evidence of a generalized vascular disease which affected also the spinal vessels.

CASE. M. B., aged 50 years, except for an attack of influenza 5 years previously, was well until May, 1913. At that time while in bed he suddenly experienced a sensation of coldness and of pins and needles in his toes. These sensory disturbances continued and were soon followed by gradual loss of power in the right leg. Shortly thereafter he developed obstinate constipation and somewhat later fecal incontinence. The condition remained unchanged for about 7 years when following an appendectomy for a ruptured appendix he lost control of the bladder and developed painful and recurring cramp-like attacks in his right leg. The numbness in that leg became very marked so that



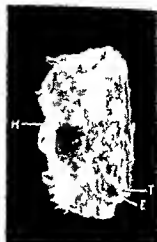
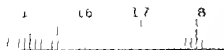
Fig. 13 Drawing showing location and type of hamangioma (Case 6, Table IV)

he would frequently burn himself because of failure to recognize the higher degrees of heat. Three and a half years after the onset of symptoms he entered the Mount Sinai Hospital.

There is motor weakness in both legs, greater on the right. There is a right foot drop. The deep reflexes in the lower extremities are barely elicited even with reinforcement; no Babinski and lower abdominal reflexes absent. There is hypalgesia below the first lumbar with partial analgesia on the right side. The disturbance in temperature sense follows the same distribution; vibratory sense is lost below the anterior superior spines; postural sense is lost in the toes. The manometric test shows no subarachnoid block with an initial pressure of 180 millimeters, pressure on coughing 200 millimeters on straining 200 millimeters on jugular compression 200 millimeters. The cerebrospinal fluid is cloudy; it contains six cells per cubic millimeter. Wassermann test of blood and cerebrospinal fluid is negative. Lipiodol injection into the cisterna magna showed no block.

The patient's stay in the hospital was marked by loss of his right knee jerk, the appearance of a bilateral Babinski sign, hyperactivity of the ankle jerks and the appearance now of hypalgesia from the first to the third lumbar greater on the right, bilateral analgesia below the second lumbar with normal sensation retained in the third to fifth sacral (Fig. 7). The legs became spastic. Electric tests gave normal responses. The picture was considered as that of an extramedullary neoplasm affecting mainly the roots of the cauda equina.

An exploratory laminectomy was performed by Dr. Elsberg. When the dura was opened and traction put on it there was active bleeding from the dura and a mass of enormously dilated veins covering the upper two thirds of the exposed area appeared (Fig. 8). In the lower part of the wound a little of the cord, yellowish in color, could be seen as well as numerous small vessels entering and



F 4

Fig. 14. Caudal aspect of brain. Case 1. Bl. 15.

Fig. 15. Ventralside of brain. Case 7. Bl. 16.

leaving the cord in the middle of the exposed area the same prominent loop of veins which projected back and rose the cord for at least centimeter 1 oblique for and up and closed in obstruction. The arch of another vertebra was then removed and the neck of the dura extended up and thus exposing further mass of enlarged veins covering the area of the cord so that the cord could not be seen further probing up and failed to find any obstruction. The vessel was then sutured.

In the further history of the case Dr. Fl. be g. states. A typical ten years' history of the veins of the cord in the lower part of the number of years ago under the heading of aneurysms of the cord. All the vessels were thin and small of them entering and leaving the cord substance so that it was difficult to attempt to ligate any of the vessels of the cord. The effect on the cord of shutting off the blood supply from even these abnormal vessels would certainly cause marked damage at once.

Following the operation the patient received radiation therapy and improvement in his leg. At the time of his discharge in January, 1927, he was able to get about fairly well but still there was unquestionable weakness in the lower extremities. He showed marked deep reflexes in the right leg absent in the abdomen bilaterally. Babinski and ankle clonus signs were present. He admitted another neurological examination and injection was done but no block. A few days later condition declined and he died of deep decubitus ulcer total contusion of the same part and died on November 1927.

Of note in this case is the rather sudden onset of paresthesia which were soon followed by

motor disturbances. The bladder and rectal involvement coming on later indicated an extension of the lesion into the depth of the cord. It is of significance that there was no subarachnoid block.

CASE 3. J. S. male aged 3 years suddenly developed 1 year prior to his admission to the hospital (March 1934) severe pain about the rectum for the relief of which he required

aspirin. Soon after the operation he began to experience pain in the anal region which later spread to both lower extremities and accompanied by numbness in the sole of his feet and difficulty in walking and weakness in the lower extremities. A neurosurgeon made the diagnosis of a spinal cord tumor and performed laminectomy (L4-L5) in the region of the third and fourth lumbar processes. He found no tumor but a tear in the dura mater of the cord and adhesions of the root of the cauda equina to the dura. The decompression was followed by a temporary relief but in the early part of 1934 there returned a feeling of gaster tension associated with cramp-like attacks in his feet. The difficulty in micturition there was no added marked on tip of penis.

The physical examination left larger than the right. Abdominal reflexes are markedly diminished on the right side. Both knee jerks are active and equal both ankle jerks hyperreflexic. There is bilateral clonus of bilateral Babin'ski. The lower extremities are weak left more than right. They are spastic and there is some atrophy of the muscles on the left side. Complete left and right foot drop is present. The lower narrow zone of hyperalgesia at the fourth to sixth dorsal and fifth to sixth from the fourth lumbar more marked on the left side. There is complete anal incontinence from the second to fifth sacral area.

the temperature sense over the same areas. Vibratory and postural sense is lost below the knees (Fig. 9). The spinal fluid shows increase in pressure but no block, no xanthochromia and but 2 cells per cubic millimeter. The blood and spinal fluid Wassermann tests are negative.

The findings were regarded as suspicious of an extramedullary neoplastic lesion compressing the spinal cord. A laminectomy was performed by Dr. Lilsberg, the spinal canal being opened at seventh to eighth dorsals. The dura was incised and the cord was exposed. A very large varicose vein was found lying along the left side of the dorsal surface of the cord. Cerebrospinal fluid escaped freely from above and probing upward proved negative. The spinous processes the ninth, tenth, eleventh and twelfth dorsals were then removed and the same large vein was seen running down toward the cauda equina and there were found some fine adhesions between the membranes and cord. No tumor was found and the postoperative diagnosis was varicose vein of the cord presenting the picture of spinal cord tumor. The patient made an uneventful recovery showed slight improvement and his pains were considerably relieved.

Of significance was the sudden onset followed by a fairly long clinical course. Pain in the perianal region and in the extremities was an early symptom and was soon followed by bladder difficulty. The objective findings localized the level of lesion pointed to its extramedullary situation and had some features of a neoplasm. The operative findings, however, though not as striking as in the first case, differing mainly in degree rather than in the actual anatomical alterations are better understood in the light of Case 1 and satisfactorily explain the clinical manifestations. The absence of subarachnoid block or xanthochromia deserved more weight than was given to it at the time.

CASE 4. H. G. male aged 62 years was in the hospital three times. On his first admission (August 10, 1922) he gave a history of weakness in his legs (greater on the left side) and 2 years duration. This was followed one year later by pain and paresthesias in the lower extremities (more marked on the right side) and more recently (4 months before admission) by difficulty in urination. Examination at this time showed a paraplegic gait with spasticity in the left lower extremity, greater than in the right, diminished lower abdominal reflexes, absent cremasteric reflexes, hyperactive knee and ankle jerks, bilateral Babinski sign, left ankle clonus, impairment of pain and temperature sense on the right side below the twelfth dorsal and a vague lever of hyperalgesia at the twelfth dorsal

(Fig. 10). There were varicose veins in both legs. The blood pressure was systolic 134, diastolic 74. The blood and cerebrospinal fluid Wassermann tests were negative and the urine was normal. After a short stay he left the hospital with the diagnosis of spinal arteriosclerosis or possible spinal cord tumor. He was readmitted 3 months later (Feb. 20, 1923) when he showed increased weakness in his left leg and an increase in the intensity of the burning pain in his right leg. His bladder control on the other hand showed some improvement. The neurologic status at this time showed but little change from that of his previous admission except that there was now a definite loss of vibratory sense in the left leg below the knee and over the sacral vertebrae. X-ray examination of the spine disclosed mild spondylitis. At this time an intramedullary spinal cord tumor at the level of the twelfth dorsal was regarded as the most probable diagnosis. Operation was suggested but the patient went home to consider it. He returned to the hospital 4 months later (July 5, 1923) when upon examination he showed slight change in his status. The sensory disturbances now extended to a slightly higher level (tenth dorsal). The knee jerks and ankle jerks were hyperactive and more so on the left side. The lower abdominal reflexes were absent. There was a left ankle clonus, a left Babinski sign with an equivocal right Babinski sign and spasticity and weakness in both lower extremities which was more marked on the left side. The sensory level however was not very definite and because of that the diagnosis of an extensive degenerative disease of the cord with multiple foci was favored.

Laminectomy was performed by Dr. Neuhof who removed the spinous processes from the second to the fifth dorsal vertebrae and on exposing the cord found on the right side of the cord, opposite the third and fourth dorsals, a contorted mass of dilated veins (Fig. 11). At its lower border this mass merged into veins while at its upper end there was a series of smaller veins which were closely attached to the posterior surface of the cord on one hand and to the aneurismal mass on the other. The anterior limits of the mass could not be determined but it was evident that it extended well around to the anterior surface of the cord. The latter was displaced by the aneurismal mass to the left. Ligation of the vessels was felt unjustifiable for it was feared that such a procedure would cause considerable damage to the cord. Exploration above and below the vascular tumor proved negative. The patient made an uneventful recovery from the operation but showed no change in the neurologic status. Two months later he was transferred to another institution for deep radiotherapy.

The outstanding clinical features in this case are the protracted clinical course of 3 years duration with gradual unfolding of the manifestations of cord compression and the

terminal appearance of signs of intramedullary involvement. Of significance also are the negative cerebrospinal fluid findings including the lack of xanthochromia. The operative findings place the case clearly with instances of varicosities of spinal vessels.

CASES COLLECTED FROM THE LITERATURE

The clinical records and the anatomical findings in 4 cases collected from the literature are incorporated in Table I. It is believed that all available instances of venous dilations with compression or direct invasion of the spinal cord aside from those which are not accompanied by clinical records have been included in this table. In it are recorded the more striking clinical features and only brief references to the anatomical alterations. For more detailed information the reader is referred to the original articles.

SUMMARY AND GENERAL COMMENT ON GROUP I

An analysis of the clinical features presented by the material in the first group reveals very few data of diagnostic value. However, some suggestive leads are obtained from a consideration of some clinical data under the following headings:

Age. In the group of 8 cases the ages of the patients are distributed as follows:

| | |
|-------------------------------------|---|
| In 0 d d e d d (th eal tag n e d e) | c |
| In th d d e d d | 6 |
| In f th d e d d | 3 |
| In fift d ad | 3 |
| In th d e d | 6 |
| In nth d e ad | |
| (I tw s s the w s n t g e) | |

The largest number of cases occurred in the third, fourth, and sixth decades; the smallest number in the second and seventh decades. Thus it appears that the lesion is most frequent during the more active years of adult life between the ages of 35 and 50 years.

Sex. It is significant that of the group of 28 cases, 1 occurred in males. This again would also strongly favor the belief that the physically more active are more likely to develop this form of lesion.

Trauma. In only 4 cases was trauma recorded and in only 1 instance did it directly precede the onset of symptoms. This would

minimize the importance of trauma as a causative factor.

Onset. In 15 cases the onset was acute almost precipitate, while in 9 it was less abrupt, perhaps subacute in character. In 4 cases the signs and symptoms developed gradually and insidiously.

Initial signs. Pain, motor weakness, and parasthesias stand out most prominently as initial signs, with pain as the most frequent early symptom. It had occurred as the first manifestation in 13 cases, while motor weakness occurred in 11 cases and parasthesias only in 3 cases. Each of these signs and symptoms may have occurred alone or in association with one or more of the other manifestations, as for example where motor weakness was the more prominent symptom, pain or parasthesias may also have been present.

Type of paralysis. The clinical histories of the cases collected from the literature are not particularly clear on this phase of the neurologic picture. It is certain that of 23 cases only 11 cases showed the flaccid paralysis type, while 7 showed spastic paralysis. The paralysis involved mainly the lower extremities. In only one case was there also weakness in one arm. Footdrop was a common occurrence.

Sensory changes. Here also the observations are not very accurate and yield few instructive findings. Sensory disturbances, however, in the great majority of instances were found to correspond to the level at which the lesion was found.

Course. The course is always progressive. It is not an uncommon feature for the clinical picture to gain momentum in its evolution at the very beginning of the illness, then come to a stationary period of variable length, after which further but slow progression takes place. The clinical course may extend over variable lengths of time. It may be short and of but a few months' duration, or so long as to spread over a period of 4 years. The height of the clinical picture may occur at any period in the clinical course.

The more common levels of lesions. were lumbar cord, 7 cases; lower dorsal cord, 11 cases; mid dorsal cord, 5 cases; upper dorsal cord, 1 case; cervico dorsal cord, 1 case. It would

seem that the most common levels are at the lower dorsal and the lumbar segments

Co existence of nœvus In only one instance was a nœvus found which helped in the recognition of the character of the disease

Laboratory findings Serologic tests cytologic studies manometric estimations of the spinal fluid and lipiodol tests have not been carried out systematically and hence offer no data which would permit of an analysis In a few cases in which such findings were reported they were uniformly negative

It is obvious that none of the above data may be used as diagnostic criteria but may be taken in consideration in atypical instances of cord compression along with other diagnostic possibilities It is however significant that in a large number of instances laminectomy which was carried out in the belief that a spinal cord tumor would be found had given satisfactory results in 9 of the 28 cases with partial or complete recovery A decompression alone or decompression associated with very judicious and conservative removal of veins was responsible for the improvement In only 3 cases was there no improvement following decompression by laminectomy In 8 cases laminectomy was followed by a fatal issue Here the responsibility may be traced to surgical procedure which was somewhat too aggressive the radical measures having included resection and removal of the venous dilatations Removal of such veins is always fraught with danger since in many instances these vessels invade the spinal cord and interference with such vessels will often lead to vascular disturbances and degenerative changes in the cord itself

GROUP II ARTERIAL OR ARTERIOVENOUS ANEURISMS OF SPINAL VESSELS

This is a smaller group and its members differ little clinically from those in the preceding one Their anatomical features the limitation of the alteration to a circumscribed area of a single vessel however justify their grouping under the separate heading Little need be said here about the causative or predisposing factors responsible for such vessel alteration of spinal arteries for they are not likely to differ from those causing similar

changes in vessels at the base of the brain or in vessels elsewhere in the organism Hence we pass on to the description of the individual cases

Brasch's (5) patient was well up to the age of 59 years when he rapidly developed weakness in his legs and somewhat later incontinence of urine with pain in the gluteal and perineal regions which radiated down the legs At the end of 2 years the patient was no longer able to walk A neurologic examination at this time showed a mild left central weakness of the face tremor of the hands paralysis of both lower extremities (with but slight movement in the toes still retained) absent knee jerks anesthesia in the lower extremities and hypæsthesia in the lower abdomen The patient declined rapidly and died 2 days after admission to the hospital

Anatomical findings The dura was defective from the fifth dorsal vertebra down the posterior surface of the cord thus permitting the penetration of large thickened tortuous spinal vessels From this point on the vessels were traced downward along the dorsal surface into a mass made up of numerous vascular coils and loops At the first lumbar segment they were seen to become continuous with a thickened tortuous artery which soon divided into two smaller branches On the ventral surface of the cord there was found a less markedly tortuous vessel winding its way from the second to the first dorsal where it penetrated the dura reached the pia and then continued down to the third where it divided into two small branches The vessels had markedly thickened muscle coats and widened lumina but the intima was normal and the adventitia only slightly thickened Numerous vessel loops penetrated the depth of the posterior surface of the cord with the coils of vessels taking the form of kidney glomeruli The smallest vessels showed marked thickening of the muscle coat which frequently caused occlusion of the vessel lumen In some of the spinal vessels calcification of the muscle layer was noted

Though the case is described as an instance in which the alterations occurred in the arterial tree the clinical manifestations as already pointed out differ little from those seen in venous dilatation of the cord vessels

Guizzetti and Cordero's case (26) is a very unusual instance of hematomyelia as the result of the bursting of an aneurism of the ventral spinal artery The sac of the aneurism rested between the first and second dorsal vertebrae and was nearly 2 centimeters long and was oval in shape There was hemorrhagic extravasation as far up as the fifth cervical and spread down to the ninth dorsal The wall of the aneurism consisted of hyaline connective tissues with hardly any trace of smooth muscle or elastic tissue About the aneurismal sac was a conglomeration of very

DISCUSSION: VARIATIONS OF SPINAL VIBRATIONS WITH COMPRESSION OR OTHER INVOLVEMENT OF THE SPINAL CORD—Continued

[illegible]

severe pains in the abdomen difficulty in urination and defecation and diminution of power in his legs Examination revealed inequality and fixation of pupils to light absent right knee jerks exaggerated left knee jerks Diagnosis of tabes dorsalis was made He died shortly after admission of pneumonia

Autopsy findings In the region of the third to fourth lumbar vertebrae there was a small growth covered with blood and compressing the spinal cord The veins in that region of the growth were found to be enlarged The growth was found to be microscopically an arterial aneurism

The aneurism between the pia and arachnoid as pointed out by the author apparently sprang from the branch of the posterior spinal artery which comes off from the dorsal trunk of the intercostal artery In considering the possible etiology of the aneurism lies is given as the most likely cause Although the patient denied syphilis the luetic aortitis found at autopsy is strong evidence of the presence of the disease The subarachnoid hæmorrhage may be taken into consideration as the cause of death It also throws some light on the etiology of subarachnoid hæmorrhage being due to aneurisms

Sargent's case (18) a male 44 years of age was well up to the age of 4 when he began to develop increasing weakness in the right arm and wasting of the muscles of the right hand He also had pain in the region of the right shoulder Later he began to lose power in his lower extremities and developed urinary incontinence

Examination showed loss of power in his legs profound sensory loss up to level of first dorsal urinary retention absent knee jerks active ankle jerks bilateral Babinski Spinal fluid showed an increased protein content and negative Wassermann

Laminectomy was attempted but was abandoned because of excessive bleeding The muscles and bones were permeated with numerous dilated tortuous thin walled arteries The condition was that of diffuse aneurismal varix Patient died shortly after operation

Autopsy disclosed the presence of an aneurism similar to that seen in the muscles at the level of seventh cervical containing a recent clot The cord was markedly compressed Section of the cord showed the intramedullary vessels of normal size and structure

Elsberg's case (22) male aged 54 began to have pain in the back of his neck 1½ years before operation which was followed shortly after by paræsthesias and numbness in his fingers He also rapidly lost power in his upper extremities A year later he began to lose power and suffer pain in his legs He

was bedridden for 3 months and lost control of his sphincters for about the same length of time

Examination showed spastic paralysis of the upper extremities exaggerated deep reflexes in the upper and lower extremities paresis of the lower extremities absent abdominals bilateral Babinski and clonus sensation lost in all forms below the second cervical X-ray examination was negative

The diagnosis was neoplasm within the foramen magnum extending into the cord Laminectomy including the first to fourth cervical vertebrae was done no tumor was found but when the probe was passed upward an obstruction was encountered above Patient died 2 days later from respiratory paralysis Postmortem examination showed a large aneurism of the right vertebral artery measuring 3 by 4 centimeters the medulla and cord from the first to the third cervical vertebrae were markedly compressed

Aneurisms of vertebral arteries are not very uncommon and belong rather to the intra-cranial type of lesion but in the presence of clinical features pointing to a high cervical lesion this case may be included in this group

Heboldt's patient a girl 15 years of age was well until 6 months before death Then in the course of a septic infection (erysipelas of the face) she developed a wide spread disease of the brain with such manifestations as impaired hearing fixation of pupils ptosis of eyelids athasia dementia disturbances in reflexes indicating a progressive encephalitic process

The autopsy disclosed diffuse meningitis thrombosis of the left sinus transversus multiple abscesses of the brain myelitis and an aneurismal formation of vessels alongside some capillaries showing thrombotic changes and an occasional small capillary hæmorrhage

Heboldt raised the question *whether these vessels changes in the cord were congenital or acquired* The presence of thrombosed spinal cord veins however suggested to him the possibility that they may have caused the dilatation of the venous capillaries and the aneurismal sac formations with subsequent rupture and hæmorrhage But the structure of the aneurismal formations themselves appeared to be more in the nature of a developmental congenital condition It is quite possible that this vessel anomaly is developmental in origin without any bearing on the clinical manifestation in this case and is but an incidental finding

GROUP III HÆMANGIOMA

The hæmangioma is commonly defined as a tumor composed of newly formed vessels

TABLE III—EXTRAMEDULLARY PIAL HEMANGIOMA

| C | Age | Ely Sympt mas | Lt Symp m | N | I | g | d | g | T | C | N | I | g | d | g |
|---------------|----------|--|--|--|-----|-----|-------------|--|-------|-------|-------|-------|-------|-------|-------|
| H m and B l k | Ag t g M | h th l g 4 m th l t d h p ocr un l z Opas th t | l d as g w th m p d m th p d m l t t k x r l t t u ang m m f l k n (T l dar t 5/5 y) | R t t f th k p p l s d ph z dy th bo i bl d d t t t d | D z | f h | k p p l s d | R p d d l n s p m | l m t | l m t | l m t | l m t | l m t | l m t | l m t |
| H d l h | 35 F | l b l t t f l l | N f b l t t f l l | N | d d | | | D f d p t t d t f m l p l u s Op t D th | l m t | l m t | l m t | l m t | l m t | l m t | l m t |
| C b h | 8 M | Whl p l y g d d l y x d th f t l p t d | f a u b d d t t d in th l l t foot h h p d p t h t l g w th m p l t y p d h d (3 d) | C m d t d d p l l g k d b d m l d l e g f l w m h l p p f d l d d l l b p m m C d b t m h w t d k b t t f t D s w pool m y l t | | | | C o d t d d g f b m l h p l y b m p t h t l k b u n l p z pp x u C h g f d g l l f P p o s d g u s f d m d l h d g m t m t m y m d p t t m t m p d | l m t | l m t | l m t | l m t | l m t | l m t | l m t |

(Ewing) This term however is somewhat more restricted by Borst who would under this name consider only such tumors which bear the characteristics of a new growth and in which an angioblastic process is in progress. He would exclude from this group such as culur tumor formations as the telangiectases and the cavernomata which he regards as congenital malformations rather than true new growths. Nevertheless it is still good practice to include these forms of vessel anomalies among the hamangiomata. They are usually classified as simple and cavernous.

The simple hamangiomata are of no interest to us here for they occur most commonly in the skin as naevi or telangiectasis or in muscles and seldom if ever in the central nervous system. They are composed of many capillary vessels and are more in the nature of a malformation than a new growth.

The cavernous angioma or cavernoma has the liver and spleen as the location of predilection but is not infrequently found in various parts of the central nervous system and their enveloping structures. Because of their effect on the spinal cord their occurrence in the vertebral column and the epidural space is of particular significance here.

Histologically such a tumor consists of widely dilated vascular channels which are separated by a variable amount connective tissue. The tumor is usually encapsulated and is benign in character eroding adjacent tissues but not invading them. It is very often multiple occurring in several systems or several divisions of a given system. The frequent occurrence of primary multiple angioma with multiple foci in several parts of the same system as well as the not uncommon finding of active blood formation in some of the angioma of the liver speak in favor of their congenital and embryonal rest character. The tumor may occasionally assume a malignant character but then it falls more properly into the group of the so called hemangio endothelioma.

These intraspinal hemangiomata are assembled in the third group of our material. They show certain variations in their relationship to the walls and contents of the spinal canal so that it is found convenient to classify them

TABLE 1.—VERTEBRAL HÆMANGIOMATA

| | | | | | |
|---|---------------------|---|---------------|--|---|
| C _A b | Δ _E | C l i
m f i t | D t f
ympt | N i g f d g
D g o s | A t p b d g |
| V b | V _E
F | | | | T b l t d g m t t p t
i b z |
| D l z | F | | | | Ang m f p l t b z |
| M ³ thm | Δ _E
F | A t f t f d d t b h t t f f d d t
t h d A p l d w k t
both f t h l g | 6) | P p l g D g n p d h l t | C _A l D o g m m g n g h t p l d |
| R b b t | V _E
F | | 8) | S g n f p m g l t | C d g m b d d t t d t t b
m p g t h |
| P t n | Δ _E
F | A b l m u l p | | | M l t f l g m t (L t b) |
| T m m | F | S d l t f k t h l g o o f l
d b y m p l t p b s f t h l g m b
b y w t h m b l c u p b k d b | 3 k | P p l g t t c u b l f d
t m f t h p l d | Ang m t h t b m p g n g h t
d d l d g t h p l p |
| A ₂
M ³ 33444
o | Δ _E
F | O x f u t h l l p d k d l
t f f f f f f f t m
p h t f f f f f t m | 3 | S o t p p l g b t d m l d
b l t t b l D B l d d f
t u n o p d L m t m y f
h x m h f m m l f D t h | Ang m f g h t d l t b m l p
d d h e m g m f d g m t p l
d d p m g l t (f g s) |

as follows Group III a intramedullary
Group III b extramedullary (pia), Group
III c dural Group III d vertebral

Group III a—Intramedullary hemangioma (Table II) This sub group consists of but few cases as hemangiomata in this location are apparently rare. They are also marked by a variability in the character of the initial signs and symptoms and lack of uniformity in the unfolding of the clinical picture. In only one case was surgery of a distinct service

**Group III b—Extramedullary (pial) heman-
gioma (Table III)** This group consists of
only 3 cases. Of interest here is the case of
Cobb in which the pre-operative diagnosis was
aided by the finding of a nevus in a der-
matoma corresponding to the sensory dis-
turbances. The case of Harman and Bulck
also offers interesting clinical features. The
repeated attacks of the remissions the appear-
ance of signs of meningeal irritation in the
final episode are highly suggestive of the
character of the lesion.

Group III c—Epidural hemangioma (Table IV) This the largest group of hemangiomas is of particular interest for it is in this location that this type of intraspinal vascular tumor promises most in surgical intervention. In 5 of a total of 10 cases laminectomy and removal of tumor resulted in partial or complete recovery. In one case laminectomy was followed by death. In the other 4 cases laminectomy was not at all attempted.

In the majority of instances the clinical features are such as to indicate an expanding intraspinal lesion and to point most commonly to an extramedullary location. There are however no signs for a pre operative identification of the character of the lesion. Still the indications for operative interference are quite clear particularly in view of the fair outlook for the removal of the tumor with either total or partial recovery.

Group III d—Vertebral hæmangioma (Table 1) It is commonly said that hæmangioma in the vertebral column is a rare occurrence (Kaufman Aschoff and others) but in a recent contribution Makrystas described 12 cases of vertebral hæmangioma which he was able to collect in the routine postmortem work in Lrdheim's laboratory.

He is of the opinion that such localization of hæmangiomas is not among the rarest. He ascribes the scarcity of such material in the literature to the infrequency with which signs and symptoms of spinal cord compression accompany vertebral hæmangioma. This is true of his 11 cases in which no neurological manifestations were recorded and hence their clinical histories are not included in Table V.

Makryostas made the following important observations: (1) vertebral hæmangiomas are most commonly found in late adult life; (2) hæmangiomas are seldom unilocular; they are most frequently multiple; (3) hæmangiomas are very irregular in their distribution but are most frequently found in the lower dorsal and lumbar vertebrae; (4) vertebral hæmangiomas are not infrequently associated with co-existing epidural vascular tumors, the latter being most often responsible for the manifestations of cord compression. The last statement finds support in Elsberg's case (Table V, case 7) in which an epidural hæmangioma was found alongside a vertebral vascular tumor (Fig. 15).

The available clinical histories of the individual cases in this group, with the exception of Trommer's case (Table V), are too incomplete to be of service. Because of the nature of the lesion and its tendency to multiplicity, little of course may be expected from operative interference. From the material so far recorded, no conclusions may be drawn as to whether X-ray examination of spinal column may be of diagnostic aid. There are on record only two cases in which X-ray examination of the spine was done. In Gold's case the X-ray film revealed decalcification of the involved vertebra. In the case of Permon, however, antemortem X-ray examination failed to disclose any destructive process in the spinal column, while a post mortem preparation revealed marked thinning of the bony tissue in the involved vertebra.

GENERAL SUMMARY AND CONCLUSIONS

In spite of the oft-repeated statement that aneurismal dilatations or so-called venous angiomas of intraspinal vessels are exceedingly rare and contrary to the belief expressed

by Bruns that when they do occur they are not of such a size as to produce clinical signs, we have presented here 28 verified cases illustrating this variety of intraspinal vessel alteration with signs and symptoms of cord compression. Moreover, the above number does not exhaust all of the reported cases, as other similar instances are described by Kady, Lenep, Elsberg (21), Sick, Adson and Dandy, but are not included in this survey, since they were merely mentioned in statistical studies and were not accompanied by detailed clinical descriptions. The total number of recorded instances is certainly sufficiently impressive to discount the old belief that such pathological alterations of intraspinal vessels are unusually rare.

We have already said elsewhere that the cases in Group I reveal no definite signs or symptoms which could aid in the clinical identification of the true character of the lesion. In the large majority of instances they simulate clinically very closely extramedullary tumors, including even the irritative root phenomena, but differ from them in that they more frequently show atypical manifestations because of the dissemination of the lesion or its invasion of the cord substance and in that no subarachnoid block may be disclosed by the manometric or lipiodol tests. Thus given a case with signs and symptoms of cord compression with or without atypical features of direct cord involvement with no demonstrable subarachnoid block occurring in an individual in his late adult life, a lesion in the nature of venous dilatation of intraspinal vessel may be considered among and alongside of other diagnostic possibilities. In any event an exploratory laminectomy is indicated. It is however necessary to bear in mind that in instances are not infrequent in which extensive areas of the white and gray matter of the spinal cord are invaded by such dilated vessels and have undergone degenerative changes. Hence if an exploratory laminectomy discloses dilated veins on the surface of the cord, thorough investigation of the spinal canal is required to ascertain that there is no extension of the lesion into the substance of the cord and to exclude the possible existence of a spinal cord neoplasm at a somewhat higher

level. In the event that extension of venous alteration into the substance of the cord is found decompression is all that should be undertaken for more radical steps such as removal or partial resection of the vessels may lead to fatal termination while the decompression will likely give quite satisfactory results.

We can add little to what we have already said in the introductory remarks as to the anatomical features of the lesion. It was suggested that two factors—a degenerative lesion in the vessels (phlebosclerosis) of more or less generalized character and a precipitating cause such as unusual posture, inflammatory process (meningitis), excessive muscular activity, trauma or any other factor which will impede the return flow of blood must combine in producing such anatomical alterations. The latter is not to be confused with true angio-blastic lesions.

Group II which consists of the arterial or arteriovenous aneurism of intraspinal vessels is from the clinical point of view a less satisfactory category. All that can be said is that clinically the individual members fall best into Group I while on purely morphological grounds they must be separated.

In Group III with all its subdivisions we have assembled only those cases in which the anatomical features justify the use of the term hæmangioma. It is obvious then that the term angioma or hæmangioma as in this contribution has been restricted to true vascular tumors though it is a rather common practice to include incorrectly under the term angioma conditions which are best described as venous dilatations. The existing confusion in the terminology is in part responsible for this survey and has prompted us to review all available instances of true hæmangiomas and incorporate them in this article. It was thought to be highly desirable and timely to differentiate these two conditions and put an end to the chaotic classification of such material. Clinically the hæmangiomas unlike the venous dilatations are more apt to give rise to very discrete signs of cord compression. A clinical differentiation between hæmangiomas of various localizations is difficult if not impossible with our

present state of knowledge though the opportunity offered by X-ray examination in instances in which bone rarefaction may be apparent in vertebral hæmangioma should be utilized. With negative X-ray findings laminectomy is indicated for if an angioma of the extramedullary or extradural type is found the promise for removal and permanent cure is very good. One must bear in mind however that the vertebral hæmangiomas are likely to give trouble by bleeding.

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CONTRIBUTING CAUSES OF GENITO-URINARY ANOMALIES¹

CHARLES H MAYO MD FACS ROCHESTER MINNESOTA

ANOMALIES occur not only in animal life but in all kinds of cell life. The anomalies of animals usually lead to death since no one has the desire to interfere with such natural laws except in case of domesticated animals for show purposes. Man is subject not only to the anomalous conditions which are found in the lower animals but to those connected with the higher nervous system with which he is endowed. The weight of the nervous system is half that of the embryo at three months.

One of the most serious of developmental defects is that of ectrophy of the bladder. This is sometimes associated with other defects some of which may greatly complicate the condition.

The anomalies occurring at the caudal end of the body are of clinical interest. In early fetal life the developing bladder and rectum are one. The anterior portion of the cloacal cavity consists of the allantois and wolffian ducts from which are developed the sex organs and the urinary collecting system.

Mammalian embryos may be divided into two groups those which retain functional wolffian bodies until the kidneys are sufficiently developed to excrete urine as in birds and reptiles and those in which the wolffian bodies degenerate before the kidneys reach functional ability. The first group includes the pig the sheep and the cat the second the rabbit the guinea pig man and the rat.

The allantois is the receptacle of the urine formed within the body of the embryo it is present as a reservoir only in animals with embryonic excretion and its size varies with the size of the wolffian bodies and with their stage of development.

The embryonic and fetal urinary excretion takes place wholly through the placenta in the rat in the rabbit guinea pig and man it is first through the wolffian body and later through the placenta but never through the placenta in the pig sheep and cat.

The kidney secreting tissue extends as mesothelial bodies or nephrogenic tissue from the lower dorsal vertebra down to the second sacral. They lie close together with the aorta between. This substance is supplied by many blood vessels derived from a delicate plexus surrounding and connected with the aorta. The ureter and pelvis of the kidney develop from a pouch which early appears from the lower portion of the wolffian duct. This collecting portion becomes attached to the secreting portion by climbing up the ladder of the blood supply so to speak of the nephrogenic substance. The numerous blood vessels atrophy as the pelvis of the kidney ascends to its higher position and the secreting substance arranges itself over it and forms a capsule. The two mesothelial bodies may touch each other and become fused developing the horse shoe kidney or various attachments to each other 90 per cent of the horse shoe kidneys are fused at the lower pole. Some of the mesothelial or secreting portion of the kidney may not become connected with the collecting portion and may then retain its embryonic type forming a mesothelial rest from which may develop so called hypernephroma or more correctly mesothelioma of the kidney. In other cases failure of connection between the secreting portion with the collecting cavity and continuance of secretion without elimination form congenital cystic kidneys usually double with one large cyst or multiple cysts in each.

Wherever the kidney stops in the process of union of collecting and secreting portions its renal artery develops from the major artery supplying it at the time. Thus is the lower of the upper group of five arteries or the upper of the middle group of five arteries. As growth continues the delicate vascular plexus outside the aorta disappears and the renal artery comes directly from the aorta but owing to change in position with development it may come from a lower position on the aorta from the sacral artery or from the

common iliac Malposition of the kidney is not so serious if function is not disturbed but it may lead to injury Excessive mobility is not a disease unless renal function is interfered with or the kidney in its movements disturbs some other organ thus a movable right kidney may disturb a diseased appendix the appendix however being the primary offender Mobility may interfere with delivery of urine by linking the ureter over a band of connective tissue or an anomalous artery which is occasionally present and connects the lower pole of the kidney with the aorta this is one of the original mesothelial vessels which failed to disappear and which if occurring in the upper pole would not cause harm One kidney may be missing from failure of development of the mesothelium (the secreting structure) or its failure to connect with the collecting portion Three or four kidneys may be present with an equal number of complete or partial ureters A splitting of the collecting portion at the wolffian duct causes double ureters and fused or separated double kidneys on one or both sides The division of the pelvis into several tubes connecting with one or two ureters is normal in the otter and beaver

In rare cases the proctodeum surrounded by two muscle sphincters which should connect the skin with the rectum does not form and in such cases it is not uncommon for the rectum to remain connected with the outlet of the bladder in the membranous portion of the urethra in the male or vagina in the female a remnant of the cloaca

The anal muscle may be weak normally or it may be weak because poorly innervated with rectal prolapse which sometimes occurs it is most important to know this before any effort is made to transplant the ureters as the rectum must have good control at the outlet or the patient's condition will be worse than before

Exstrophy of the bladder then should occur later than the separation of this cloaca in the rectum and bladder In most cases of exstrophy the remnant of the umbilicus scar shows at the upper margin of the exposed mucous membrane of the bladder In a small number of cases the umbilicus is normal with

good skin between it and the wall of the bladder It is significant that the last muscle to develop is that covering the urinary bladder in some cases there may be spots of deficiency—openings in the muscle exposed in the mucous membrane Through these openings a full bladder pushes out the mucous membrane and small hernias develop which become small or large diverticula of the bladder but not having any muscle they are never able to empty themselves into the bladder and are always kept full increasing in size by tension of the bladder They occasionally become infected and stone may develop within them These openings vary in size in some cases when the bladder is open they hardly show in others they are large enough to admit a thumb When the bladder is empty these diverticula remain a full as intra abdominal pressure permits

In exstrophy of the bladder the pubic bones show as lateral short stumps and are not connected at the pubic arch the urethra is split wide open above (epispadias) the bladder is also split from top to bottom and spreads out on the surface of the abdomen It appears as if the bladder before it was ready to retain urine had been compelled to receive it and thus it bulged up between the developing pubic bones and prevented their union Finally the whole sac splits from top to bottom but for a considerable period it had been dilated from holding the urine Other similar defects occur such as spina bifida caused by increased cerebrospinal fluid bulging the sac in the weaker places with less support and preventing the union of the spinal lamina which should cover the cord Rarely the central groove fails to close as a tube and a condition called rachischisis results which causes early death the spinal tube being spread open appears as a mucous membrane In rare cases the bladder is formed and completely covered with skin and the pubic arch has united but the prostatic portion the membranous portion and the spongy portion of the urethra are completely split as in epispadias and the skin on the upper side passes into the mucous membrane of the bladder muscular tissue does not develop in the lower portion Although the

surface of the bladder is not exposed to constant irritation by the absorbent cloths which are usually worn the condition should be regarded as true exstrophy and the patient made at least dry and comfortable by transplantation of the ureters into the large bowel. That carcinoma sometimes develops from chronic irritation is well known the wearing of absorbent cloths on the exposed bladder has caused cancer in six cases of complete exstrophy observed in the clinic. The ages of the patients varied from 22 to 46 years.

The experience of transplanting the ureters for exstrophy of the bladder has led to similar procedures in cancer of the base of the bladder which is attendant with such constant suffering. In such cases we have transplanted the ureters and removed the bladder to the great relief of the sufferers.

Until recently the public did not know that something could be done for such defects but now patients of all ages are coming for consultation in the hope that something can be done. The chronic rubbing of the exposed surfaces results in fibrosis around the ureteral outlets and older patients as a rule have greatly dilated ureters and hydronephrosis or pyonephrosis. In some cases a diagnosis is made by roentgen ray examination after the ureters have been injected with something opaque which readily shows their size and the condition of the pelvis of the kidney. Some degree of inguinal hernia is common in exstrophy probably in the male this is due to failure of attachment of the gubernaculum which should fix the testis and as the body elongates and grows away from it hold the testis in place for development in the scrotum. If the testes are undescended they become sterile and cystic. Sometimes the uterus is partly divided at the fundus or it may be completely divided emptying into one cervix or the uterus may be double with two cervices and vaginas. I have seen two cases of the latter condition.

Since the cloacal state is the natural one in fowls it early came to mind in the treatment of these cases to divert the urinary flow if possible into the rectum.

The loss of full nerve control in this period of development might occur as a result of

spina bifida occulta which is not infrequently associated with the anomaly of exstrophy. Secondary trouble from the traction on nerves might develop since the opening in the bone usually at the upper sacral segment or lower lumbar segment may so fix the cord structure by the attachment of the dura that the rapid overgrowth of the spinal column previously the same length as the spinal cord injures the pelvic nerve by tension. Some cases of enuresis are due to spina bifida occulta in this lower region reducing the strength of the normal automatic control.

In past ages through evolution many types of life came on earth that were found wanting in various particulars and disappeared or some made further changes and in a different manner continued to exist for example the dinosaurs with small heads and brains long necks and big bodies cold blooded egg laying animals disappeared. Nature and evolution dislodge waste and whenever possible they use tissues for other purposes when the type of structure and the form of life change.

Spina bifida is a possible complication in exstrophy of the bladder. It is of interest to note that where spinal fluid appears near the skin the hair grows. In the adult then a patch of hair in an area on the median line of the back probably means that it covers posterior spina bifida occulta although there is no bulging in the area. It does not occur in the anterior type.

The change of the invertebrate to the vertebrate was a drastic one as the cephalic stomach with its straight gut was behind the nervous system in the invertebrate and became changed to a position in front of the nervous system in the vertebrate.

In the human embryo between the seventh and the twenty second days there are 3 days in which the large central tube of the spinal column which at this time is larger than the large bowel is connected with the large bowel at a small opening called the neuroenteric canal. During the last year two patients in this condition were seen in the clinic both with cerebrospinal fluid at times leaking into the large bowel. They had suffered from many attacks of meningitis and

they were both brought in during attacks and died. It was then learned that their suffering had been caused by this very unusual condition.

The invertebrate was unfortunate in being controlled at the site of intake of food. His mouth was completely surrounded by the nervous system, a ring of it giving touch and taste. With increased development of the nervous system, the olfactory nerves with the brain areas for muscle function, the ganglions for sight and later for hearing were placed over the cephalic stomach. The digestive fluids developed from areas of cells on each side of the stomach, small masses of cells which resemble the cells of the liver and pancreas. The stomach emptied into a single straight gut, the intestinal system which accomplished little work by peristalsis, mostly by cilia, just as in the trachea and in the fallopian tubes. It is said that at the third month of life of the human embryo, the lower third of this tube in the center of the spinal cord, which represents the old straight gut of the invertebrate, is filled with loose hair-like cilia. Later these are absorbed.

Kubie and Fulton recently reported two new cases of teratomatous cysts of the spinal cord and reviewed many from the literature. The cases are all most interesting and corroborate the claims that the ciliated columnar cells in the tumors with mucus were remnants of the evolution of the straight gut with smooth muscle and similar cells of the invertebrate. Some of the cells and new growths are found in the ependyma and choroid areas of the ventricles, the digestive fluid areas of the invertebrate stomach. The report is excellent but stops just short of the true solution of the anomaly. The more brains the invertebrate developed, the more difficult it was for him to get food into his stomach. Some of the invertebrates, however, became quite large; the ancient giant sea lobster was five feet long. The semi-mucous membrane structure which we now call the ventricles of the brain and which has been enfolded by the enormous development of man's greater nervous system still retains on the sides of the ventricle in the ependyma of the choroid plexus the area which produces

the cerebrospinal fluid. It is possible that some chemical stimulus acting on the secretory part of this structure could make fluid enough by stimulating the cells which once made the digestive fluid and now make cerebrospinal fluid to cause the development of hydrocephalus or hydrocephalus and spina bifida or spina bifida alone with less of the fluid formed.

I once saw a small child who was born with spina bifida which ruptured early. The skin was reddened and softened about it just as occurs in a leaking pancreatic cyst or fistula of the duodenum. In the early weeks of the life of the human embryo, the spinal cord and the spinal column grow equally in length and in the fourth month the spinal column rather rapidly outgrows the spinal cord. The nerves are brushed downward with this growth and the cauda equina develops. The legs have developed shortly before this and nature to prevent traction on the nerves to the legs fused the outer covering of the spinal cord, the dura and pia, with the lower end of the central tube of the spinal cord and attached this onto the end of the coccyx. Thus as the spine grew it took traction off the nerves. But if this filament was not strong enough if it stretched too much or if it pulled off, then the child should be born with club feet, a condition occasionally seen with spina bifida. In this area too are lost out particles of nervous system which in the embryonic stage may through some stimulus develop growths, the nerve tissue tumors of the pelvis and those about the coccyx and sacrum. The most common dermoids or partial dermoids are the pilonidal cysts in which this terminal filament is connected near the coccyx close to the skin; it draws the skin in making canals with a small bunch of hair projecting from them or sometimes true closed dermoids.

Today it is possible to determine the presence of twins long before birth by the use of the stethoscope and the roentgen ray. In the old days an excess of fluid or the large abdomen of the pregnant woman made her physician think of the possibility of a defective baby. Is there a change in the chemistry of the fluid to change embryonic develop-

ment as found by Loeb who in experiment ing with frog s eggs found that by developing the fertilized egg in 0.5 or 0.6 per cent sodium chloride solution anomalies of the nervous system frequently resulted?

I have of course discussed only a few of the anomalies found in man. The others are equally interesting but they are not often found associated with exstrophy of the bladder the subject of the evening s discussion

THE ADRENAL FACTOR IN HYPERTHYROIDISM¹

G. W. CRILE M.D. F.A.C.S. CLEVELAND OHIO
CL 14 CL

ADRENALIN causes increased heart action and increased pulse pressure hyperthyroidism causes the same

Adrenalin causes dilatation of the vessels of the skin and sweating hyperthyroidism causes the same

Adrenalin causes dilatation of the pupils hyperthyroidism causes the same

Adrenalin increases metabolism hyperthyroidism does the same

Adrenalin tends to produce hyperglycemia hyperthyroidism does the same

Adrenalin has a profound effect on the gastro intestinal tract hyperthyroidism has the same

Adrenalin activates the nervous system hyperthyroidism does the same

The symptoms of hyperthyroidism then are the same as the symptoms of adrenalism. It would appear therefore that hyperthyroidism as it is revealed by its symptoms should more appropriately be called hyperadrenalism than hyperthyroidism. We shall presently see however that neither of these terms hyperthyroidism or hyperadrenalism is adequate to describe this disease.

The injection of adrenalin in a patient having hyperthyroidism produces an exaggeration of every symptom of hyperthyroidism. On the other hand no amount of thyroid extract or of iodine can immediately cause any symptom of hyperthyroidism.

Experimental evidence also confirms the clinical observation that as the thyroid activity is increased the effect of adrenalin on the organism is stepped up in a sort of mathematical ratio. One fact alone is sufficient to show that the production of adrenalism is

dependent on the thyroid namely that in myxedema the injection of adrenalin has little or no effect. In the presence of thyroid deficiency adrenalin loses its power but it is also true that in the presence of adrenal deficiency as in Addison's disease there can be no hyperthyroidism. Therefore the thyroid and the adrenal glands are each equally essential to the production of hyperthyroidism.

Let us now consider the exciting causes of hyperthyroidism especially the conditions that may cause thyroid crises. These data are significant for they disclose that the chief perhaps the only causes of thyroid crises are those factors that cause an increased output of adrenalin. The factors which cause thyroid crises are the following: (a) pain (b) emotional excitement (c) foreign proteins—auto intoxication wound secretion focal infections infectious diseases (d) asphyxia (e) inhalation anesthesia (f) hemorrhage and (g) the injection of adrenalin.

These are the only factors known to me clinically that can precipitate a thyroid crisis. What common factor in asphyxia hemorrhage physical injury emotional strain infection etc. is responsible for the thyroid crisis? Obviously it is adrenalin for each of these factors except the injection of adrenalin is capable of producing an increased output of adrenalin. Moreover no other recognized clinical condition causes an increased output of adrenalin.

On the other hand what factors do not cause an increased output of adrenalin and do not aggravate a case of hyperthyroidism? Neither food nor drink nor electrolytes nor narcotics nor stimulants nor sleep nor rest

nor a normal daily routine nor any other factor in the whole external and internal environment can either cause an increased output of adrenalin or precipitate a thyroid crisis

We now see that the expression of the disease is the result of increased adrenal activity but only in association with increased thyroid activity. I have seen no cases in which hyperthyroidism has been associated with a normal thyroid gland and I have not seen a single case of hyperthyroidism in which the patient's condition did not improve after the removal of an adequate portion of the thyroid gland. The adrenal and the thyroid factors both play vital roles in the production of hyperthyroidism. We shall presently see what is the role of each of these but before taking up that point we must also identify one other essential factor namely the nervous system.

The great role of the nervous system is shown by the following facts:

1. In hyperthyroidism physiologic rest is one of the most effective forms of treatment.

In many cases the cause of the disease can be traced to excessive nervous strain.

3. Ligation of the superior thyroid artery which produces a break in the innervation of the thyroid gland profoundly modifies the disease and usually converts a hyperplastic gland into a resting gland.

To these should be added the following biologic fact:

1. That the disease occurs only in members of the human race the principal characteristic of which is the development of the nervous system—especially of the brain and

That among the human race hyperthyroidism rarely occurs in the inferior peoples nor in the stupid and criminal classes of the white race.

All these facts indicate that the nervous factor belongs to the picture almost as definitely and potentially as do the adrenal and the thyroid factors.

It is clear then that there are three dominant factors in the production of hyperthyroidism—the thyroid gland the adrenal glands the nervous system. Let us now introduce experimental and clinical evidence indicating the role of each of these factors.

Let us recall that the brain is the master organ and that through its nerve connections it drives the organism that oxidation is the source of that driving force that the trillions of cells of which the organs are composed are electrochemical units and that each of the cells is surrounded by a film the variation in the permeability of which causes a variation in the activity of the cell. One would expect therefore to find some organ the sole function of which is that of changing the permeability hence the activity of the cells of the organism. This organ is clearly the thyroid gland. The thyroid hormone causes a specific increase in the permeability of all the cells hence an increased activity of the trillions of cells of the body. An important consequence of this specific action of the thyroid gland is an increase in the electric potential and in the electric conductivity of the tissues. Increased electric potential determines the range of the functional power of the organs and tissues. Comparable to an electric battery a high potential means a high energy producing power hence high ability for work. In other words the role of the thyroid is to build up the potential in the cells of the working organs and to increase the conductivity of the tissues. These important facts have been verified by measurements made in our Biophysics Laboratory in collaboration with A. F. Powland and Maria Telkes.

Furthermore our researches have shown that in myxedema both the conductivity and the potential of the tissues are exceptionally low a fact in harmony with the clinical observation of the stupor and low metabolism of myxedematous patients—the opposite state to that in hyperthyroidism.

Apparently we have disclosed the definite role played by the thyroid gland. But we must at once point out a role which the thyroid gland cannot play. The thyroid cannot discharge the cells of the organs and tissues the potential of which it build up. This is inevitable as in man-made batteries the charging and the discharging mechanisms are separate and distinct mechanisms. Obviously the mechanism for charging a battery can no more discharge the battery than can the mechanism that discharges a battery charge it.

The animal cells the tissues the organs—the whole organism in which the rate of accumulating a charge is governed by the thyroid gland has no more power to discharge itself in work done than is possessed by a plant cell. Were there no discharge mechanism a healthy human would be as quiescent as a healthy turnip. But the human has a marvelous discharge mechanism which is entirely separate from the thyroid gland—the discharging mechanism is the nerve adrenal combination.

Our researches on electric potential have shown that in each case the effect of the injection of adrenalin the effect of nerve stimulation and the effect of electric stimulation is to discharge the potential as energy is drawn off to do work. The active work—excessive work in hyperthyroidism—is due to the action of the nerve adrenal mechanism.

The thyroid mechanism is the charge up mechanism the adrenal nerve mechanism the discharge or work mechanism. Obviously therefore neither of these can substitute for any one of the others. Nor can any one work without the others.

How interesting it is therefore that the principle of anoci association which has been evolved on the basis of clinical experience in cases of hyperthyroidism has as its objective the avoidance of these very factors—pain emotion infection anæsthesia hemorrhage and how naturally may one expect a high recovery rate after the removal of an excess portion of the charge up mechanism—the thyroid—if stimulation of the discharge mechanism the death dealing mechanism—the adrenals—is avoided by the elimination or minimization of these factors. The recovery rate is indicated by the following statistics. Among 1244 cases in which information is available 1219 or 97.9 per cent of the patients are reported to be in good or fair condition more than 1 year after operation.

Furthermore how clear and logical is the postoperative care which has as its chief objective as complete an avoidance of excitation of the discharge mechanism during the postoperative period as is attained during the operation. As stated there is strong evidence that the activity of the thyroid is under the

control of the discharge mechanism—namely the nerve adrenal mechanism.

Thus to recapitulate

1 Nervous excitation is known to be a cause of many cases of hyperthyroidism.

2 Relief from nervous strain leads to relief of symptoms and the return of the hyperplastic gland to the normal.

3 In cases of hyperthyroidism the division of the nerve supply of the thyroid causes great improvement sometimes even a complete disappearance of symptoms and the return of the hyperplastic gland to the normal.

4 Every one of the known excitants of hyperthyroidism namely infectious diseases focal infections emotional excitation etc involves nerve excitation which in turn produces an increased output of adrenalin. The adrenalin in turn, has the power of activating the thyroid.

In view of the above considerations it would appear that a primary adrenalectomy would have both immediate and remote advantages in cases of extreme hyperthyroidism. The immediate advantages are indicated by a comparison of the early postoperative course of patients after thyroidectomy and after adrenalectomy. After thyroidectomy the patient is at first extremely nervous and difficult to quiet after adrenalectomy the patient is usually quite calm and rests well. By adrenalectomy therefore the acute exacerbation of the hyperthyroidism which is so dangerous in cases of extreme hyperthyroidism is avoided. After thyroidectomy the pulse rate is usually very rapid and remains so for several hours often increasing in rate rather than decreasing after adrenalectomy the pulse rate gradually drops. More sedatives are required after thyroidectomy than after adrenalectomy. Excessive perspiration is noted after thyroidectomy and but a moderate amount after adrenalectomy. As for the remote results the permanent lessening of the discharge mechanism that is of the adrenal tissue lessens the probability of recurrence of the disease after the removal of a portion of the hyperactive thyroid.

It is obvious that we are now approaching an understanding of hyperthyroidism and are still increasing our ability to cope with

the disease successfully. The foregoing considerations at least supply an interpretation of the exciting causes of the symptoms and the clinical course of the disease. They offer an interpretation of the dominance of the brain in definite physical terms: they point out clearly the physical basis for psychic management and for the role of focal infections and infectious diseases; they show that the thyroid, the adrenals, and the nervous system are each affected by each of the others and that in turn each affects each of the others—a necessary arrangement for the primitive energy transforming system—a system which transforms potential into kinetic energy.

The nerve receptors are the means whereby this energy system adjusts the organism to the environment etc. The nervous system is passive until activated; the adrenal is quiescent until activated; the thyroid is quiescent until activated. In the role of the automaton thus created, the thyroid is driven to govern the potential and the permeability and with it the activity of the countless cells of the organism. The adrenal and the nerve mechanism cause

a discharge of energy which is manifested by work done—emotion, exertion, etc.

When one considers this correlation of the thyroid, the adrenals, and the nervous system as evidenced by clinical observation and by experimental data, especially by the evidence accumulated in biophysical researches, it becomes clear that a new name must be given to the disease which we have formerly associated only with the thyroid by the term hyperthyroidism.

TABLE I—SUMMARY

| | |
|--|------------|
| Mortality of thyroidectomy | 6 per cent |
| Total operative deaths of thyroid | 8331 |
| Total thyroidectomy | 3090 |
| Total ligations | 54 |
| Total thyroidectomy of hyperthyroidism | 943 |
| Adrenalectomy for hyperthyroidism | |
| Unbooked cases July 3, 1918 | 46 |
| Thyroidectomy and adrenalectomy | 4 |
| Ligation | 31 |
| Gandtal | |

This included partial peat nfo malgn thyroid with metastases to the lung

PARAVERTEBRAL ANÆSTHESIA IN UROLOGY

WITH A REPORT OF ITS USE IN ONE THOUSAND CASES OF THE KIDNEY AND URETER¹

HAROLD B. HERMANN, M.D., BROOKLYN, NEW YORK

AND

FUGENT DÓZSA, M.D., BUDAPEST, HUNGARY

SINCE the disadvantages that may be encountered in the use of general anesthesia are well known a detailed discussion of them is hardly necessary. The heart, the lungs and primarily the kidneys are not indifferent in their action when ether, chloroform or nitrous oxide is used as an anesthetic. The influence of these anesthetics on kidney function has long been an object of study. Many authors (Thompson, Haines and Milliken) have been able to demonstrate that there is delay during general anesthesia in the appearance of indigo carmine from both kidneys.

Grondahl examined the urine of 75 patients after ether narcosis and was able in 36 per cent of the cases to show albumin.

S. Pascual's work on the effect of general anesthesia on kidney tissue is of interest.

In normal structure the epithelial cells in the convoluted tubules have a striated border which is thought to play an important part in urinary secretion. Pascual made histological examination of kidney tissue after a general anesthesia had been used and found that this striated border of the epithelial cell was lacking. The general result of narcosis is an oliguria without a disturbance in the concentrating power of the kidney. However, a patient whose kidneys have a lowered concentrating power will develop a postoperative nitrogen retention if he receives a general anesthetic. If we lay aside the disadvantages of general anesthetics we still find that in various pathological conditions paravertebral anesthesia is undoubtedly the method of choice. In arteriosclerosis, severe cardiac lesions, myocardial degeneration, tuberculosis of the lungs and bronchial asthma the use of paravertebral anesthesia has a distinct advantage.

Local anesthesia has come to assume an important rôle in modern urological surgery.

Frequently the surgeon is confronted with cases in which the use of a general anesthetic is contra indicated. If a renal deficiency exists before operation or the remaining kidney demands operative attention then local anesthesia becomes the method of necessity rather than of choice.

Certain conditions must be fulfilled in order to insure a successful result with paravertebral anesthesia. The surgeon must have (1) the co-operation of the patient, (2) he must use a good anesthetic and (3) he must use the proper technique.

THE PATIENT

In working with any form of local anesthesia it is of paramount importance to gain the confidence of the patient and make him less apprehensive. In this Clinic all of the operations are performed under local anesthesia and the patients have come to expect this. As a result the patient comes to operation with a feeling of security and confidence. Persons of low mentality who are of a distrustful frame of mind and cannot overcome this tendency (neurasthenic or hyperæsthetic individuals) are not proper subjects for paravertebral anesthesia; hence another form of anesthesia is advisable in such cases.

The evening before operation the patient is given 0.5 gram of veronal. Thirty minutes before the patient is taken to the operating room 0.02 gram of morphine sulphate are injected. The veronal insures a night's sleep; the morphine lowers the sensibilities.

ANÆSTHETIC

Novocain is used in this Clinic as the anesthetic of choice. It has proved to be the least toxic, most reliable and least expensive anesthetic. The novocain solution is prepared from novocain-adrenalin tablets which are dissolved in a physiological salt solution.

7 Superior Ramus

Anterior Ramus

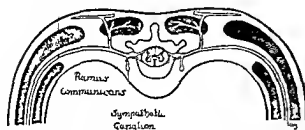


Fig. 1. Sagittal section of the thoracic and lumbar regions.

Each tablet contains 0.125 gram of novocain and 0.00015 gram of adrenalin. The 1 per cent solution of novocain which is the strength used to produce paravertebral anesthesia is prepared by dissolving 8 of these tablets (pharmaceutical division of Bayer Meister Lucius) in 100 cubic centimeters of physiological salt solution. This solution must be freshly prepared before each operation and sterilized by boiling. It is then cooled and ready for use. The adrenalin content of the anesthetic by its action in constricting the blood vessels makes possible a slow absorption of the novocain. Thus the action of the novocain is more intensive and lasting, being effective for a period of 2 hours.

TECHNIQUE

In discussing the technique necessary for a proper administration of the anesthetic it may not be amiss to review a few anatomical relationships primarily the course of the nerves to be anesthetized. The region of the abdominal wall that must be incised in operations upon the kidney and ureter is innervated by the intercostal and lumbar nerves. The intercostal nerve as it emerges from the intervertebral foramen travel with the artery and vein of the same name in a sulcus on the lower and inner border of the rib. These structures which lie behind the pleura proceed with the ribs anteriorly. Where the intercostal nerve makes its exit from the intervertebral foramen it gives off a communicating branch the ramus communicans to the sympathetic chain. This sympathetic chain which is connected with the intercostal nerve

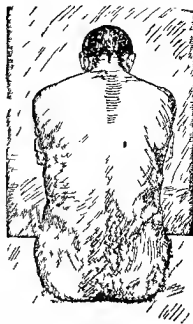


Fig. 2. The position of the patient during the paravertebral anesthesia. The patient must lie prone with the lumbar region in a position to receive the injection.

through the rami communicantes runs down on each side of the vertebral column. It is composed of chains of ganglia each ganglion lying in an intercostal space. The intercostal and lumbar nerves together with the nerve arising from the twelfth thoracic (iliohypogastric nerve) and the nerve arising from the first lumbar (ilioinguinal) innervate the abdominal wall. The sympathetic fibers innervate the kidney, the adrenal, the ureter, peritoneum and the other abdominal organs. It is possible therefore by directly infiltrating the intercostal and lumbar nerves at the point where they emerge from the intervertebral foramen which is the site where the ramus communicans takes origin to produce an anesthesia not only in the abdominal wall but especially in the kidney and ureter.

In order to obtain a good anesthesia in operations of the kidney and ureter we block from the eighth to the twelfth dorsal nerves that is the last 5 intercostal nerves and the first lumbar nerve. If it be once necessary to work on the lower ureter it is more advantageous to anesthetize in addition the second and third lumbar nerves. Recently some urologists have advocated blocking only

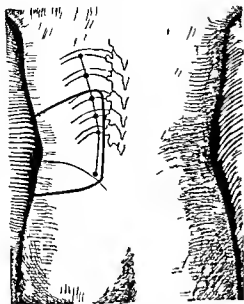


Fig. 3. Points of injection over the lower border of rib (eighth to twelfth) and the iliac crest. The space marked out by the dark lines shows the area that is anesthetized through both the paravertebral anesthesia and the local infiltration (after Braun).

the eleventh and twelfth dorsal and first lumbar nerves while others have attempted to work with an anesthesia of only the twelfth dorsal and first lumbar nerves (von Lichtenberg).

The technique of paravertebral anesthesia as used in this Clinic is as follows: the patient sits upon the operating table with his legs hanging over the edge. He is told to cross his arms in front of him, bend slightly forward and arch his back. Aided by an assistant he maintains this position. In this way the intercostal space is increased and the ribs can be more easily palpated. The lower angle of the scapula which marks the location of the seventh rib is located. The next lower rib is the eighth. At this point we begin the anesthesia. In stout patients it may be difficult to make out the lower angle of the scapula. If the patient is told to move his arm and shoulder up and down the scapula will move also and in this way give us a landmark.

At the level of the eighth rib we palpate the spinous process of the vertebra. Two to two and a half fingers breadth lateral from this point and on a level with the lower border of the eighth rib we place a small wheal of novocain in the skin as a guide. This is done in the same manner with each rib until the

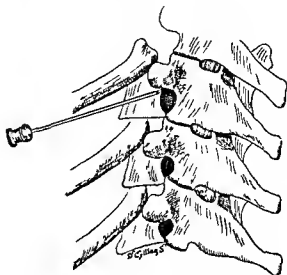


Fig. 4. The needle is shown being directed parallel with the rib to the transverse process of the vertebra and the intervertebral foramen.

twelfth is reached. Then a wheal is made over the iliac crest just lateral to the long muscles of the back. Using a thin needle from 9 to 12 centimeters in length we begin at the eighth rib where the first wheal was made. The needle goes through the skin and underlying soft structures until the lower border of the rib is reached. There 3 or 4 cubic centimeters of 1 per cent novocain solution are injected. Care must be taken not to injure the pleura. In stout persons in whom the needle must pass through a thick layer of soft underlying tissue it may be difficult to find the lower border of the rib. In such cases one can carefully use the needle directly as a guide to the body of the rib, taking care however not to injure the sharp point of the needle which would hinder the sense of feeling necessary for the fine work to follow. When the rib is found the needle is moved slowly downward until the lower border is reached. By this method it is possible in very stout patients to inject the novocain precisely under the lower border of the rib and thus obtain a good anesthesia. Contrary to the view held by other workers who state that it is immaterial whether the upper or lower border of the rib is injected we have found that in view of the small amount of anesthetic introduced the best result is obtained when the injection is made exactly at the lower border.

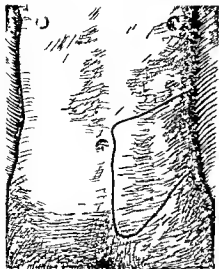


Fig 5 The lines mark the point of the paravertebral infiltration used in operations on the kidney (after B. A. J.)

It should be stated that in the anesthetizing of the intercostal nerve the so called intraneural injection is made difficult on account of the situation of the nerve in the costal sulcus. Therefore a perineural infiltration must be given. Three to four cubic centimeters of the novocain solution are sufficient to reach and anesthetize the intercostal nerve. When the novocain has been injected against the lower border of the rib the needle is withdrawn a few centimeters and its point is directed toward the vertebra and parallel with the rib. The needle is slowly carried forward until a bony resistance is felt which is the vertebra. We inject 3 or 4 cubic centimeters of the novocain solution at this point. This technique is carried out from the eighth to twelfth rib.

The injection at the rib border blocks the intercostal nerve while the injection of novocain at the vertebra anesthetizes the rami communicantes and through this there results an anesthesia of each segment.

From the last wheel on the twelfth rib and then that over the iliac crest the infiltration is carried downward in a fan shaped manner using from 50 to 25 cubic centimeters of novocain solution. This results in a blocking of the ilio inguinal nerve.

In operations on the lower ureter the lumbar nerves are anesthetized in the following

manner. The lumbar nerves as they emerge from the vertebral foramen take a direct and straight path downward. To block these nerves we palpate the spinous process of the lumbar vertebra and 3 centimeters lateral from this point we introduce a needle going through skin and muscle in the direction of the transverse process of the lumbar vertebra. When the needle meets bony resistance 3 to 4 cubic centimeters of the solution are injected. This is carried out with the first, second and third lumbar vertebra.

After the regional anesthesia is completed the line of incision is infiltrated by means of the usual method first subcutaneously and then deeper into the muscle layers.

In operations on the kidney 150 cubic centimeters of novocain solution are used. In cases in which the ureter is laid free in its entire length or one meets with a very thick abdominal wall an additional 50 cubic centimeters of the solution must be used. This is for the anesthesia of the lumbar nerves and to provide for the longer incision.

At this Clinic the results with the technique for paravertebral anesthesia described have been practically 100 per cent successful in providing good anesthesia.

It happens not infrequently that when the renal pedicle is clamped the patient experiences some degree of pain. However in most cases this is negligible. Finsterer and Torek have described a method of paravertebral anesthesia in which they recommend after isolation of the kidney the injection of a small amount of novocain into the pedicle and surrounding peritoneum. Other authors advocate that a light ether anesthesia be given during the ligation of the renal artery and vein. It has not been found necessary to apply either of these methods in the work at this Clinic.

Some workers who perhaps have not had the opportunity to use paravertebral anesthesia in a large number of cases are of the opinion that it is not practical for general use in urological surgery. Von d. Huetten on the basis of 7 cases reports that this method of anesthesia is complicated and difficult. In our review of 1000 cases with paravertebral anesthesia we are able to state that the method

is simple and uncomplicated. A little practice enables one to give this form of anæsthesia with assuredness.

It has been said in speaking of the disadvantages of paravertebral anæsthesia that its administration requires time. In a clinic with a full operating schedule too much time would be necessary to carry out this anæsthesia. However this is not a real objection since with a good technique it can be given in about 10 minutes. An assistant having scrubbed earlier can complete the anæsthesia by the time the operator is ready to begin work. When one operation must follow another in order to avoid delay an assistant leaves the table a short time before the operation is finished and prepares the next case.

The toxic action that results in the use of an amount of novocain solution necessary for this anæsthesia is said to be a disadvantage and danger. We can state on the basis of 1,000 cases in some of which 2 or 3 grams of novocain were given in $\frac{1}{2}$ to 1 per cent solution that we have not seen any toxic action from the drug. Furthermore no untoward results have occurred from the adrenalin content of the solution. In nervous patients the drug may at times give rise to slight symptoms such as cardiac palpitation, a rapid and small pulse, dizziness, cold sweats or vomiting. Collapse has not occurred in a single case. The slight symptoms just mentioned are ascribed to cerebral effects due to the absorption of novocain. It is questionable if the morphine given preoperatively is not responsible in part for these symptoms.

Finsterer describes another disadvantage of paravertebral anæsthesia that makes its use impractical as a routine procedure. He has observed in a few instances that the dura can protrude into the intervertebral foramen and even bulge out to the point where the sympathetic ganglia is situated. In view of this it is possible by injecting according to the technique of paravertebral anæsthesia for the needle to enter the dura. Thus a large amount of novocain entering the dura could produce serious effects. Kappis in reviewing 32 kidney operations under paravertebral anæsthesia reports 1 death. In this case he was able to demonstrate the presence of novocain

in the spinal fluid. Among the 1,000 cases reported in this article no similar experience has occurred.

It has also been said against this form of anæsthesia that the adrenalin in the solution gives rise to a secondary dilatation of the blood vessels and thus makes liable a postoperative hemorrhage. Careful hæmostasis will avoid this. Here we can state that in our series of cases there has been no postoperative hemorrhage that could be ascribed to the action of the adrenalin. Druener recommends that in order to avoid the injection of the solution into the blood vessels the infiltration be carried out from layer to layer beginning with the operative wound. Kappis first infiltrates his line of incision, cuts down, uses a splanchnic anæsthesia, and then infiltrates the adipose capsule of the kidney. He claims that by thus injecting in two stages he avoids the danger of introducing adrenalin into the larger vessels.

Splanchnic anæsthesia is recommended by some authors. The technique necessary for this method is more complicated and dangerous than is the paravertebral method. Investigations show that splanchnic anæsthesia influences kidney function.

A Schmidt and P. Swan found that several hours after splanchnic anæsthesia there was a sharp decrease in the urinary output. They observed this in one third of their cases. In 25 per cent of the cases there was a decrease in the output of nitrogenous products in the urine. Salt excretion was practically uninfluenced.

The administration of splanchnic anæsthesia is not without danger. Kappis in his technique introduces a needle at the lower border of the twelfth rib posteriorly. The needle is directed upward and medial for a distance of 7 centimeters which is the point where the semilunar ganglion lies and where the splanchnic major and minor nerves take origin. The novocain solution is injected at this place. It must be remembered that on the right side the vena cava and on the left side the aorta are close to the semilunar ganglion. Therefore in carrying out a splanchnic anæsthesia the danger of injury to these great vessels is not remote.

TABLE I—SUMMARY OF CASES

| Initial | Final | Type | Par | U | Cas |
|--|-------------------|----------------------------|-------|---|-----|
| T. b. e. j. o. | f. t. h. k. d. y. | N. phr. | t. my | | 508 |
| F. d. n. e. y. c. l. u. l. | | { N. phr. c. t. my | | | 87 |
| | | { N. ph. t. my | | | 6 |
| | | { I. l. t. my | | | 3 |
| U. e. t. e. a. l. l. u. l. | | U. e. t. t. o. m. | | | 43 |
| H. y. d. n. p. h. i. | | N. phr. e. t. o. m. | | | 49 |
| I. y. e. p. l. | | N. e. p. h. t. o. m. | | | 3 |
| I. y. l. n. e. j. t. n. d. p. l. t. i. | | { N. phr. t. o. m. | | | 3 |
| a. p. t. m. t. a. (u. g. c. a. l. k. d. e. y.) | | { D. p. l. a. t. | | | 4 |
| K. i. n. y. t. u. m. o. r. | | N. e. p. h. r. t. o. m. | | | 3 |
| M. i. l. e. k. d. y. | | N. p. h. r. o. p. e. y. | | | 5 |
| H. a. e. m. h. e. c. p. l. t. | | D. e. p. l. a. t. n. | | | 6 |
| F. u. m. o. f. e. l. p. e. l. | | N. e. p. h. r. e. t. o. m. | | | 4 |
| P. l. y. y. t. i. k. d. e. y. | | { E. p. l. t. o. y. | | | 3 |
| | | { N. e. p. h. r. t. o. m. | | | |
| | | { N. p. h. c. t. o. m. | | | |
| | | { N. e. p. h. r. t. o. m. | | | |
| U. t. r. o. a. g. n. i. f. i. t. l. a. | | | | | |
| C. o. l. t. a. l. a. n. o. m. l. i. e. o. f. t. h. e. k. i. d. n. y. | | | | | |
| b. i. p. l. a. | | F. p. l. t. o. y. | | | 6 |
| H. y. p. o. p. l. a. | | N. e. p. h. r. t. o. m. | | | 3 |
| H. e. l. o. k. d. e. y. n. d. l. u. l. | | N. p. h. r. o. t. m. | | | 6 |
| d. D. o. l. l. e. k. i. d. n. e. y. | | { N. p. h. t. o. m. | | | |
| | | { H. m. e. p. h. t. m. y. | | | |
| L. a. g. i. t. y. s. e. o. u. y. s. t. | | E. o. n. | | | 3 |
| F. l. c. o. u. y. t. k. i. d. e. y. | | F. o. n. | | | 1 |
| TOTAL | | | | | 508 |

Many surgeons prefer and recommend the use of spinal rather than paravertebral anesthesia because it is simple and requires only one site of injection. In view of the serious results that are often seen following spinal anesthesia we believe that in kidney surgery paravertebral anesthesia offers a safer and better method.

Rannucci in a series of 67 cases studied the effects of spinal anesthesia on kidney function. He found that following such anesthesia the urinary output is diminished and the urea nitrogen of the blood is increased. In one third of the cases he found albumin in the urine. This he explains as being due to the action of the novocain on the cerebral centers. Conducting his investigations along the same lines in cases in which paravertebral anesthesia was used he was not able to find any changes in the blood or urine such as were found in the spinal anesthesia cases.

In all operations that they carried out under spinal anesthesia Abadie, Baldous and Dornier noticed that there was an increase in nitrogen of the blood. E. Bamberger reports his observations in 166 cases operated upon under spinal anesthesia. He found regularly

an increase in body temperature. This occurred between the fifth and sixth days postoperative in other cases between the eighth and twelfth days or sometimes this fever developed at both these periods. With the increased temperature meningeal symptoms and also severe headaches appeared. There was an increase in the nitrogen products of the blood and a decrease in the output of phenol sulphonephthalein and indigocarmine.

In addition to these slight and transitory symptoms which spinal anesthesia produces some authors report more harmful results. Salleras observed a case in which after an operation under spinal anesthesia a paralysis of the detrusor muscle of the bladder occurred. This patient developed incontinence of the urine and feces which persisted for 3 years. Salleras stated that this paralysis was due to an injury of the urinary and defecation medullary centers by the needle.

The influence of paravertebral anesthesia on the kidney function was studied by K. Lion who observed 100 cases. He found in his series that there was no increase in the urinary output or urine salts after paravertebral anesthesia.

Protopapow, Neuwirth and Andler do not confirm the results of Lion. They are able to report that with this anesthesia no evidence of disturbance in kidney function has been observed.

In writing of his experiences with paravertebral anesthesia Lowesley reports that the blood pressure is not lowered as in spinal anesthesia nor is it increased as frequently occurs with inhalation anesthesia. He further states that the danger of lung complications is practically negligible. He sees as a great advantage the fact that the patient can partake of liquids immediately after the operation which is of prime importance in kidney surgery.

If we review the various methods of narcosis described in this article and compare the disadvantages of inhalation, splanchnic or spinal anesthesia with the advantages to be gained by using paravertebral anesthesia we cannot help but feel that in the surgery of the kidney and ureter paravertebral anesthesia is the method of choice.

In this Clinic during the past 10 years 1 000 operations on the kidney and ureter were performed under paravertebral anæsthesia. A summary of these operations is set forth in Table I.

The operations were all carried out in a most favorable manner. There were 10 cases in which a minimum amount of ether was given during the ligation of the renal pedicle.

In conclusion we wish to state that in this Clinic most satisfactory results have been achieved with paravertebral anæsthesia.

SUMMARY

1. One thousand operations upon the kidney and ureter with paravertebral anæsthesia are reported.

The disadvantages transitory or permanent which arise with inhalation, splanchnic or spinal anæsthesia are not met with in the use of paravertebral anæsthesia.

3. A markedly neurotic and apprehensive patient should not be selected for this form of anæsthesia.

4. There is no contra-indication to the use of paravertebral anæsthesia such as a low or high blood pressure, poor renal function, cardiac lesions or pulmonary involvement.

5. The safety of this anæsthesia has been in our experience absolute.

6. Its technique is uncomplicated and easily carried out.

7. It is the anæsthesia of choice in surgery of the kidney and ureter.

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PERIURETHRAL PHLEGMON (URINARY EXTRAVASATION)

A STUDY OF ONE HUNDRED AND THIRTY FIVE CASES¹

MEREDITH F. CAMPBELL, M.D., F.A.C.S., NEW YORK

A. J. G. L. N. W. L. K. N. ry d. Ch. d. D. p. tal. Adj. U. log. 15 g. B. H. H. p. l. A. V. g. S. gro.

SO CALLED urinary extravasation is an extensive fulminating phlegmon originating in or about the urethra and is usually accompanied by massive genital and perigenital gangrene. It claims a mortality of over 40 per cent. The lesion is always an infection; most often follows pre-existing urethral disease—notably stricture—but may be secondary to trauma. In private practice the condition is rarely encountered; in large hospitals it is frequently seen and since convalescence is protracted at Bellevue Hospital we are seldom without at least one such case in the wards of the Urological Service. As a rule the diagnosis is correctly made and if the lesion has been observed once one could scarcely fail to recognize it again. Treatment is surgical and should include immediate establishment of free urinary drainage together with inordinately wide incision of the involved areas.

During the past 14 years 135 patients with periurethral phlegmon have been admitted to Bellevue Hospital and all but of these were treated on the Urological Service. Two infants, 3 and 6 weeks of age, were admitted to the Children's Surgical Service. This series constitutes the basis of this study.

ETIOLOGY

For anatomical reasons periurethral phlegmon is a disease peculiar to males. Although a third of our patients were between the ages of 45 and 60 no age was exempt (Table I). Two were infants without demonstrable urethral obstruction yet extensive operation was required. However urethra scarred and ulcerated by infections past and present often weakened and dilated by the long continued urinary back pressure secondary to stricture offered the least resistance to infectious flare-ups. As a rule the inflammatory process is most severe at the site of stricture or old peri-

urethral infiltration. In only 7 cases was an antecedent gonorrhoeal infection denied. Twenty patients had been operated upon for stricture previously and 1 had been previously operated upon for extravasation.

Unless it follows recent trauma the lesion is always of a primary infectious etiology. The straddle injuries of the perineum are the common trauma as in 4 of our patients. Following transverse rupture of the urethra by a crushing blow urinary infiltration with accompanying infection and cellulitis ensues. Phlegmon may complicate fracture of the pelvis. We have recently observed a patient in whom extravasation followed urethral laceration by instrumental trauma. In Barwell's case () the lesion followed rupture of the membranous urethra during intercourse. While urethral obstruction (stricture) is found in the majority of extravasation cases (85 per cent in this series) its presence is not essential. Primary obstruction by urethral calculi has been observed by some but such stones were not identified with our cases. In one patient however 11 calculi were found impacted behind a tight stricture at the junction of the pendulous and bulbous urethra. Suppurative periurethritis, adenitis (lithitis Cowperitis) and periaidenitis with secondary localized urethral necrosis and phlegmonous infiltration account for certain cases without demonstrable stricture. There is still another group presenting an apparently intact urethra with no evidence of actual urinary infiltration yet characterized by massive gangrenous phlegmon and clinically indistinguishable from the lesions in which urinous infiltration is present. Some have designated these as idiopathic but we believe them to be likewise of periurethral infectious origin. We observed 2 cases of the 2 latter types 11 patients died. Because of the severity of the inflammatory reaction in most instances it is quite impossible to

estimate to what degree the urethra has been involved by the periurethral process

We have not considered as belonging to this non stricture group a series of 295 cases of localized periurethral abscess observed during the period covered by this study nor cases of streptococcus scrotal and penile gangrene. Most periurethral abscesses are secondary to gonococcus infection although many times other organisms can be demonstrated. While these abscesses are acute suppurative lesions pathologically not unlike the group designated as extravasation and are restrained by the same fascial planes as extravasation we do not associate them clinically with the more extensive gangrenous phlegmons because they are localized. However it is conceivable that by marked extension a previously localized periurethral abscess might become clinical extravasation but the 2 cases of this series in which gonococci were demonstrated were both associated with stricture. Furthermore we have not included those cases of urinary infiltration due to rupture of the bladder ureter or kidney.

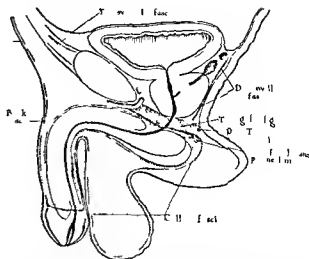
Bacteriologically streptococci staphylococci bacillus coli bacillus perfringens and various anaerobes are most often etiologically associated with extravasation. Certain observers particularly the French have emphasized the etiological importance of these anaerobic bacteria and have pointed out that without anaerobic invasion there will be no gangrene (5). However a mixed infection is always present the colon bacilli in many cases accounting for the nauseous stench emitted by the lesions.

ANATOMY

The extension of periurethral phlegmon is guided by certain anatomical structures the external and internal pelvic fasciæ. A correct

TABLE I—AGES OF PATIENTS

| Y | Ca |
|--------------|-----|
| 19 and under | 2 |
| 20 to 29 | 1 |
| 30 to 39 | 25 |
| 40 to 49 | 8 |
| 50 to 59 | 39 |
| 60 to 69 | 26 |
| 70 and over | 3 |
| Total | 135 |



F1 x Fasciae of importance in urinary extravasation (after Weir) Colles fascia is concerned in nearly all extravasations and its abdominal continuation Scarpa's fascia is less frequently involved. Intrapelvic extravasations are least commonly observed.

knowledge of the surgical anatomy of these planes is essential not only for a proper understanding of extravasation but also for its correct treatment. The present anatomical conception of these structures is indicated diagrammatically in Figure 1. The triangular ligament is the dividing line. It is a densely fibrous wall formed by two fascial layers: a firm anterior and thin posterior layer. It stretches across the pubic arch and is attached anteriorly to the symphysis pubis laterally to the ischiopubic ramus and posteriorly offers insertion for the all important Colles fascia. Between the layers of the triangular ligament courses the penile vascular and nerve supply and within its confines are the membranous urethra and the ducts of Cowper's glands.

As indicated Colles fascia, or more correctly the superficial perineal fascia is firmly attached to the posterior border of the triangular ligament from which point it sweeps first backward and downward separating the deep and superficial transverse perineal muscles then forward. It is firmly attached laterally to the ischiopubic ramus continues anteriorly under the perineal scrotal and penile skin to fuse with the deep penile fascia at the root of the organ. A compartment is thus formed—the anterior perineal triangular space—closed everywhere except at the base of the penis. Through this unprotected area extravasation

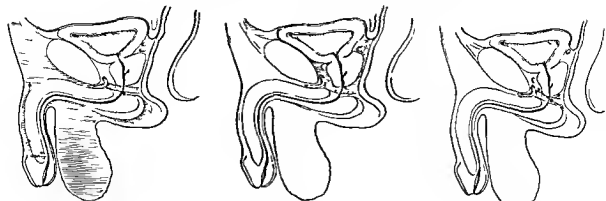


Fig 1
l b Sp d f t t w l t l m s f l
l ant t t t l l h l l g m t A
bo d l l y C l l d S t f at t h p l l
F z Wh t t t t t t t t t t
f th t gul l g m l l p t t l tal l
f t f f l t t o m t m m l l l

Fig 2
l b Sp d f t t w l t l m s f l
l ant t t t l l h l l g m t A
bo d l l y C l l d S t f at t h p l l
F z Wh t t t t t t t t t t
f th t gul l g m l l p t t l tal l
f t f f l t t o m t m m l l l

Fig 3
l b Sp d f t t w l t l m s f l
l ant t t t l l h l l g m t A
bo d l l y C l l d S t f at t h p l l
F z Wh t t t t t t t t t t
f th t gul l g m l l p t t l tal l
f t f f l t t o m t m m l l l

extends upward over the abdomen beneath Scarpa's fascia which is the abdominal continuation of Colles' fascia. In the groin the firm attachment of the superficial abdominal fascia (Scarpa's) to Poupart's ligament quite generally prevents invasion of the anterior thigh. In only 2 cases did we find involvement in this latter location both of these patients presenting extensive abdominal and genital infiltrations which had broken through the barrier at Poupart's ligament. The anatomical identity of the deep penile fascia of Buck and the fascia of Colles is disputed but Wesson (7) on the basis of injection experiments has recently described these as separate structures (Fig 1).

These are the main anatomical considerations and infiltrations which originate anterior to the triangular ligament will follow a course limited in the perineum and genitals by Colles' fascia and over the abdomen by Scarpa's fascia (Fig 2). Perineal and scrotal involvement is noted first and if neglected or improperly treated penile, lower abdominal and groin cellulitis immediately succeeds. Less often is the site of origin in the pendulous urethra and here penile involvement may be localized by Buck's fascia or may be followed by upward extension over the abdomen. Rarely is the scrotum or perineum secondarily involved when the process originates in the pendulous urethra. If it originates on pelvic side of tri-

angular ligament retroprostatic extension most often occurs (Fig 3). This usually invades the ischio-rectal fossa and may include the buttocks and inner upper aspects of the thighs. In one case coming to autopsy retroperitoneal infiltration extended up the lumbar gutters to the kidney level. When intrapelvic infiltration points anterior to the urethra a prevesical or perivesical phlegmon results. At autopsy cases showed this lesion with fatal secondary peritonitis. Unless pointing immediately into the ischio-rectal fossa intrapelvic extravasation rarely manifests itself early enough to offer great hope of surgical cure.

When the primary inflammatory lesion is between the layers of the triangular ligament the infiltration may point either way—toward the pelvis or more often externally—always taking the course of least resistance (Fig 4). Occasionally direct extension to the ischio-rectal spaces may occur as we observed 4 times or may secondarily involve these spaces after penetrating Colles' fascia. The relative frequency with which the various structures were involved in our cases is indicated in Table II. The extent of the lesion depends upon the site of origin, the virulence of the infection and the duration of the disease. We have seen cases of 7 hours duration with infiltration extending from the perineum to the costal margins and by this time genital gangrene had occurred.

PATHOLOGY

Most frequently there is urethral necrosis with subsequent perforation at or proximal to a stricture. This urethral gangrene may result from mechanical urinary pressure against a dilated weakened and infected membrane but is probably more often the result of acute local infection (flare up) at the site of stricture or in an area of periurethritis. Mechanical factors explain some cases while infection explains all. In proof of this patients have been observed in whom the origin of the infiltration was distal to a stricture. Afforded egress through the diseased urethra the infected urine incites the widespread phlegmon. It has been proved by injection that sterile urine will not incite this process (8).

French observers (1, 2) in particular hold that actual urinary infiltration does not exist that periurethral phlegmon is caused by bacterial invasion only—notably anaerobic and that fluid in the tissues simulating urine is an acute inflammatory exudate. On the other hand Kidd (6) repeatedly found a 2 per cent urea content in fluid obtained from the tissue at time of operation. In 2 cases at Bellevue in which this test was made, urica was found. Therefore there may be phlegmon with or without urinary extravasation.

After the lesion is a cellulitis with associated extensive vascular thrombosis resulting in early gangrene. Invasion of the tunica vaginalis, spermatic cord or corpora cavernosa or spongiosum seldom occurs although we have observed the incidence of each.

With chronic urethral obstruction upper urinary tract dilatation and infection coexist and are dependent upon the duration and degree of the blockage. In 2 cases no phenol sulphonephthalein was obtained in 2 hours observation and in 3 others only a trace was found (Table III). Acute superimposed

TABLE III—LABORATORY FINDINGS*

| | | | | | | | | | | | | | |
|---------------------------------|----|-----|------|----|--------|----|----|---------|----|---|---|---|----|
| Ph | l | lph | phth | l | (| h | t |) | C | | | | |
| None | | | | | | | | | 2 | | | | |
| Trace | | | | | | | | | 3 | | | | |
| 5 to 10 ^{cc} | | | | | | | | | 5 | | | | |
| 11 to 20 | | | | | | | | | 7 | | | | |
| 21 to 30 | | | | | | | | | 9 | | | | |
| 40 to 50 | | | | | | | | | 6 | | | | |
| Over 50 | | | | | | | | | 5 | | | | |
| Cult | | | | | | | | | C | | | | |
| Conococcus | | | | | | | | | | | | | |
| Streptococcus | | | | | | | | | | | | | |
| Staphylococcus | | | | | | | | | 6 | | | | |
| Bacillus coli | | | | | | | | | 4 | | | | |
| Ga. facilli | | | | | | | | | 3 | | | | |
| (anaerobes not bacterial Welch) | | | | | | | | | | | | | |
| N | p | t | t | b | (mgm p | | | m bl l) | C | | | | |
| Under 35 | | | | | | | | | 7 | | | | |
| 36 to 50 | | | | | | | | | 19 | | | | |
| 51 to 70 | | | | | | | | | 7 | | | | |
| Over 70 | | | | | | | | | 6 | | | | |
| Highest | | | | | | | | | 28 | | | | |
| C | t | | | | (mgm p | | | m bl d) | C | | | | |
| Under 1 | | | | | | | | | 2 | | | | |
| 1 to 2 | | | | | | | | | 8 | | | | |
| 1 to 3 | | | | | | | | | 44 | | | | |
| 3 to 4 | | | | | | | | | | | | | |
| 5 | | | | | | | | | 1 | | | | |
| B | p | ld | th | al | phl | gm | lw | y | m | g | y | p | d |
| d | t | m | p | m | t | f | p | op | t | f | t | t | th |
| ly | ll | l | l | l | l | l | l | l | l | l | l | l | l |
| | | | | | | | | | | | | | |

pyelonephritis is often encountered and in some instances is the immediate cause of death (10 cases).

SYMPTOMS

The toxic symptoms of cellulitis overshadow all others save those of acute urinary retention when urethral obstruction is present. Marked local tenderness and swelling, chills and fever succeeded by toxic mental confusion often progressing to delirium and coma are the outstanding symptoms. The intensity of both local and general symptoms is governed by the degree and duration of the phlegmon. Constitutional resistance is a feeble factor in the face of an overwhelming bacterial toxæmia such as that produced by the streptococcus for example. The majority of these patients have long battled more or less fortuitously with stricture, periurethral abscesses and renal infections. Little resistance indeed can these men offer to bacterial invasion with its attendant gangrene more especially when the heart also has been damaged by cardiovascular degeneration.

TABLE II—STRUCTURES INVOLVED BY EXTRAVASATION

| | C |
|---------------|----|
| Scrotum | 04 |
| Penis | 7 |
| Perineum | 60 |
| Prostate | 6 |
| Altogether | 34 |
| Buttock | 4 |
| Thigh | 1 |
| Circumference | 17 |



Fig 5 The h cte t c ppe e o dm sion In th ca penul gang en wa p ou ced and rot l gang e w far d a d



Fig 6 Mak dp e l d penilem l em t Altho gh s otal in olvem t p ese t in th ca t not d va ed s i usually berved o dm t the h pital

Dysuria and other urethral symptoms are usually pronounced. Urinary difficulty was noted by 7, diminished stream by 49, dribbling by 21, marked frequency by more than half, hematuria by 19, gleet by 18, and burning or painful urination by 35. Fourteen patients were admitted in acute complete retention and 8 were in chronic complete retention with overflow.

The onset of phlegmon is abrupt. Occasionally patients have noted the presence of nodular periurethral infiltrations for some time previous to the acute onset. Most often the lesion is heralded only by acute dysuria immediately followed by swelling and the signs and symptoms of phlegmon. The duration of the phlegmon as noted by our patients is indicated in Table IV. The lesions alleged to be of 3 to 5 months' duration (5) were

TABLE IV.—DURATION OF PHLEGMON TO KNOWLEDGE OF PATIENT*

| DAYS | C | W | K | C |
|------|---|---|---|---|
| | 6 | 1 | 2 | 0 |
| 3 | | | 3 | |
| 4 | 0 | | 4 | |
| | 5 | | 5 | |
| 6 | 4 | | 0 | |
| | | 9 | 1 | |
| 4 | 9 | 4 | 1 | |
| 3 | | | | |

obviously large periurethral infiltrations which had recently and suddenly burst their bound

DIAGNOSIS

The correct diagnosis is often made by inspection. One finds a bulging perineum and a greatly swollen purplish red scrotum which looks as if it were about to burst (Fig. 5 and 6). The surface is frequently spotted with areas of greenish black gangrene and emits the odor characteristic of decomposition in flesh. A similar picture may be presented by the penis, groins, and suprapubic abdominal wall. The genitalia are often 6 to 8 times normal size. Palpation reveals this enlargement to be an oedematous cellulitis and urethral instrumentation will usually disclose an obstruction. These patients look sick, they are apt to be dehydrated, have rapid pulse and respirations and may be delirious or even comatose. Nine of our patients were in coma when admitted to the hospital.

Extravasation must be differentiated from the massive oedema of cardioneuropathy, cirrhosis, etc. In these latter cases oedema

TABLE V.—ANESTHESIA

| | Case |
|----|------|
| G | 1 |
| I | 1 |
| Sp | 1 |
| | 4 |
| | 54 |
| | 3 |



Fig 7 Postoperative appearance of lesion similar to that shown in Figure 5. The scrotal incision and debridement are noteworthy as are also the freely swinging testicles

elsewhere particularly of the lower extremities gives the diagnostic clew. Urinalysis will rule out diabetic gangrene although this is seldom an isolated lesion of the scrotum. We have recently seen a case of extravasation which had been operated upon under the mistaken diagnosis of strangulated hernia. There was present scrotal gangrene and universal cellulitis of the lower half of the abdomen. Herniotomy incision revealed advanced subcutaneous gangrene. A similar error was made some time ago in another case in which the extravasation first involved but one side of the scrotum.

Streptococcus scrotal and penile gangrene most closely simulates extravasation. There is lacking however a history of antecedent urethral disease; stricture cannot be demonstrated; perineal involvement is rare and always secondary to a genital inflammation and in all cases studied by us (3) a pure culture of hemolytic streptococcus longus was isolated. In most respects this lesion is not unlike an intense erysipelas of the genitals and incision fails to reveal evidence of periurethritis. Nevertheless at Bellevue one case of this type was operated upon under the mistaken diagnosis of extravasation.

Hydrocele orchitis or acute epididymitis can hardly be confused with extravasation.



Fig 8 Extensive incision scrotal bi-fection and perineal bladder drainage in an infant 6 weeks of age. An insufficiently incised oedematous penis is noted.

TREATMENT

The immediate establishment of free bladder drainage together with wide incision of the involved tissues and the administration of enormous quantities of fluids offers the only hope for these patients. Under spinal anesthesia a perineal section is performed; the strictures are cut to admit the passage of a large sound to the bladder and a perineal bladder tube is fastened in place. Inordinately wide drainage incisions are then made throughout the involved areas extending well into the margins of normal skin.

About half of our patients were operated upon under general anesthesia (gas oxygen ether) but since 1906 we have been using spinal anesthesia in most and since 1924 in all of these cases. Spinal anesthesia is now the anesthesia of our choice for most major urologic surgery (4). Four moribund patients were incised under local anesthesia; 3 required no anesthesia (TABLE V).

TABLE VI—TYPE OF OPERATION PERFORMED—ALL WITH INCISION AND DRAINAGE OF SKIN

| | |
|-----------------------------------|-----|
| External urethrotomy | 101 |
| Internal urethrotomy | 3 |
| External and internal urethrotomy | 5 |
| Incision and drainage only | 4† |
| No operation | 2‡ |

134

All dead after treatment of drainage
† No bladder drainage
‡ No bladder drainage

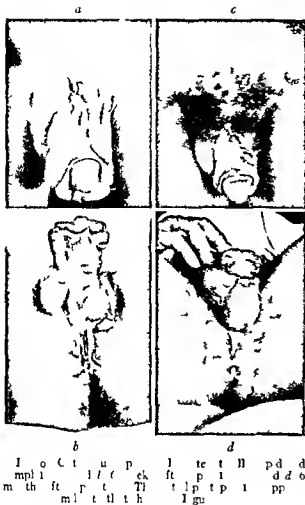


Fig 1 Sho g complet heal g with t t r
 t tl pe fle the re ult of d sho te b d r
 t mall hyd o le is p e t the ht f
 Fig 2 Th hg aft u ued to cel rat c t
 u p Th al how the ch te a d te f th
 d g o f am de at up ap t e t t

tients in whom plastic urethral operation were later performed were subsequently drained from above. In those cases in which the location of the stricture was recorded the sites were as follows: penile 12, bulbous urethra 2, bulbomembranous 12, and membranous 3.

Having established bladder drainage one immediately incises the involved areas widely, bisecting the scrotum when necessary and performing debridement of gangrenous portions. This frequently leaves the testicle swinging freely but is life saving (Figs 7 and 8). Incisions should be carried into the margins of healthy tissues. If this is not done further infiltration may occur and necessitate reoperation for extension of incisions. We found that of 12 patients requiring reoperation because of further infiltration 9 died.

Furor incision is the patient's death warrant (Keyes) and not a few of our patients have been bilaterally incised from the perineum to the costal margins.

The preservation of free bladder drainage and an enormous fluid intake are chief of the postoperative measures. Upon renal function rests the battle for life in most instances. We not infrequently give at least 1, hypodermoclyses of 1,000 cubic centimeters each in 4 hours in association with a voluminous fluid intake by mouth and continuous rectal drip. If the heart continues to function properly

If the stricture is of filiform caliber as in 18 of our cases or is impassable as in 12 others the injection of a half ounce of methylene blue solution into the urethra will often aid in the recognition of the lumen of the canal when perineal incision is performed (Table VI). With proper urethral surgical technique and an accurate knowledge of perineal anatomy one can usually contrive to enter the urethra, cut the strictures, and insert the perineal tube into the bladder. In those cases in which this is found impossible suprapubic cystostomy must be done. Because new avenues of infection are thereby opened particularly into the prevesical space of Retzius one hesitates to perform cystostomy. More especially is this true when suprapubic cutaneous extension of the cellulitis has occurred. In no case of this series did the primary bladder drainage require suprapubic approach although 5 pa-

TABLE VII—RELATION OF DURATION OF DISEASE TO MORTALITY INCIDENCE

| Dy
th
op | Dy—D t (D) | | | | | | | | | | |
|----------------|------------|---|---|---|---|---|----|----|----|------|-------|
| | 1 | 3 | 4 | 5 | 6 | 8 | 10 | 11 | 14 | Over | Total |
| 2 to 5 | 1 | 3 | 2 | 2 | 2 | 4 | | | | | 15 |
| 6 to 10 | 1 | 1 | 2 | 1 | | 2 | | 1 | | | 15 |
| Total | 5 | 3 | 6 | 8 | 6 | 8 | | 4 | 11 | | 57 |

V t p t d p

There is no danger of waterlogging the patient. The perineal tube is left in place for from 5 to 7 days. Occasionally after its removal chills, fever, and signs of urinary sepsis develop, and if these do not immediately subside indicate the necessity for replacement of the drainage. Many patients have been given hot tub baths in a dilute permanganate solution (1:10,000) as soon as they can be safely transported. This not only makes for cleaner wounds but stimulates the repair process. If strictures have been cut, the passage of sounds is begun from 7 to 10 days after operation and continued every 5 to 7 days. Scrotal regeneration is rapid and complete (Figs 9 and 10). Penile cutaneous repair has been accelerated in some cases by the use of Thiersch grafts (Fig. 11).

Postoperative complications are predominantly those of sepsis and renal insufficiency. Seven patients died of pneumonia, 4 of cardiac failure, and 1 of paralytic ileus. Fifty-eight of these 133 patients died (before operation could be performed) a mortality of 49 per cent. A fourth of these deaths (15) occurred within 24 hours postoperatively (Table VII). All but 3 of this group had had the phlegmon for 5 days or longer. A study of Table VII indicates that of 17 patients who had had this lesion for less than 5 days, 8 eventually died and of 71 suffering from 5 to 14 days, 36 died—

a mortality of substantially 50 per cent in each group. Of 12 patients known to have had phlegmon over weeks, 11 died. Therefore the earlier the patient can be operated upon the more favorable will the ever grave prognosis become.

SUMMARY

Because periurethral phlegmon is a rapidly fulminating infection which kills nearly half of its victims, the early recognition of the nature of the lesion together with the immediate institution of proper treatment is of prime importance. The prognosis rests not only upon the virulence of the invading organisms, the site and duration of the disease, but upon the degree of renal damage which has occurred. Treatment is surgical, radical, and is always an emergency procedure. Delay and meager incisions are fatal. Free drainage must be afforded the urinary bladder and the involved cutaneous tissues. Genital cutaneous repair is rapid and satisfactory. When stricture has been demonstrated, periodic dilatation with sounds must be employed faithfully after operation according to the usual custom for all urethral strictures. Such treatment constitutes the only prophylaxis against future phlegmons.

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THE INCIDENCE OF STRICTURE OF THE URETER¹

KENNETH FRATER MD CH B ROCHESTER MINNESOTA

F l l w m U l s r Th M y F d at

AND

WILLIAM F BRAASCH MD ROCHESTER MINNESOTA

S to U l g y Th M s Cl

RECENT articles concerning the incidence of stricture of the ureter found at necropsy would lead one to believe that they are common the percentage of incidence varying from 3 to 90. The material studied however has been too limited both as to number and selection of cases to afford a comprehensive survey of the question. A close analysis of the cases reported shows that many of them are not confined to the type of stricture which urologists have recently described clinically. In order to determine the incidence of strictures that cause obstruction to the introduction of a catheter

or sound as well as of the so called wide stricture further investigation of a large series of ureters removed at necropsy seemed necessary. To attain even approximate accuracy in such analysis it seemed to us that material available in a general hospital where all types of diseases occur at all ages should be studied. We therefore instituted a series of postmortem examinations and are reporting our observations so far as they have been carried out.

One of us (Frater) completely removed both kidneys and ureters in 93 unselected cases at necropsy. The organs were inspected *in situ* and then removed either intact or with the kidneys detached above the ureteropelvic juncture. Forty eight of the subjects were males and 35 were females. Each decade of life up to the eighth was represented including 7 in the first decade.

Röntgenograms were taken of the kidney and ureter in 14 cases and of the ureter alone in 3. The ureter was filled by gravity with a column of fluid (30 per cent sodium bromide) held 37.5 centimeters above the level of the ureter.

After the length of the ureters had been noted olives attached to a flexible steel guide were passed up the ureter. The size of the olive causing obstruction and the site of the obstruction in terms of distance in centimeters from the ureterovesical orifice were ascertained. In the passing of the bulbs care was taken not to use too much pressure. The bulbs were passed from No. 8 French up to the size producing obstruction in sequence. Thus if obstruction to a No. 14 French was noted it indicated that a No. 13 French bulb did not meet with obstruction. A section of the ureter about 1 centimeter in length was removed from the site of obstruction and six sections were made through this area after it had been embedded in paraffin. The sections



Fig. U t l in th p s of c n t l l y
m a l l m t s h y d t d p h s i s m p p h l f f
d p l a t e d k d

R d b f A m A s s o u t I G t L y S g o W h g M y s



Fig 2 Roentgenogram showing stricture of the middle portion of the left ureter with dilatation of the ureter and pelvis



Fig 3 Dilatation of upper half of right ureter with pyelectasis. Stricture was not present on microscopic examination

were stained with hematoxylin and eosin and van Gieson's stain for fibrous tissue and were then examined microscopically.

It should be stated that of the 93 subjects studied 40 were embalmed and 53 were not. Of those that were embalmed none was examined more than 10 or 12 hours after death, most of them being examined 4 or 5 hours afterward. The postmortem changes in the tissues of the ureter would therefore be comparatively insignificant. Furthermore it was noted that there was not much difference in the data obtained from ureters that had been embalmed a few hours than from those that were not embalmed. Although the absence of muscle tone or reflex spasm present in the living subject might make a difference in the size of the sounds passed, still it would hardly affect the data obtained as to the comparative diameter of the ureter in various areas.

The average size of the bulb that met with obstruction was between No. 1 and No. 13 French. There was little difference in the sexes or in the embalmed and unembalmed tissue. In four male subjects bulbs varying from No. 16 to No. 20 French were not obstructed in one ureter. In one male subject obstruction was not met in either ureter to

No. 19 French. In three female subjects obstruction was not met to bulbs varying from No. 18 to No. 19 French in one ureter and in one female subject a No. 20 French was not obstructed on either side. It is evident that the caliber of the normal ureter is far from uniform. It is not unusual to observe a normal ureter which will not permit a bulb larger than No. 9 to be introduced without obstruction. On the other hand an equally normal ureter may permit a No. 19 or No. 20 bulb to pass easily throughout. The fallacy of endeavoring to determine areas of abnormal constriction by means of measuring the caliber by a bulb when the normal limits are so variable is obvious. The size of the bulb which may be introduced without obstruction in the normal ureter varies from No. 8 to No. 20. Forty-four per cent of the obstructions were within the first centimeters of the ureter. This included the intramural portion and that immediately adjacent in some cases. The next most frequent site of obstruction was from 2 to 4 centimeters from the bladder and composed 17.5 per cent. Most of the obstructions in these two groups correspond to the site of the third physiological zone of narrowing. In the first 6 centimeters therefore 68 per



Fig 4. C t t l k f t l u t l
d t b t u d l g l m h h d m t t d
h l t h g t t (X 8)

cent of the obstructions occurred. According to some observers this corresponds to the site at which stricture is most frequently diagnosed. The area 6 to 12 centimeters covers the second physiological zone of narrowing and obstruction was met there in 17.5 per cent of the ureters.

CRITERION OF STRICTURE

A stricture is a narrowing beyond the normal anatomical and physiological limits of a hollow muscular tube. The question may well be raised: What are the normal anatomical and physiological limits?

If all ureters were of the same caliber and there was an established normal caliber it would be a simple matter to diagnose a stricture by means of bulbs. Just as the urethra in one individual may be smaller than that in another, so normal ureters in different individuals may vary in caliber. In the same individual one ureter may have a greater diameter than the other.

Gross strictures are readily diagnosed at necropsy. They are characterized by marked localized narrowing of the ureter with dilation above the site of the stricture. Definite obstruction to small bulbs can be demonstrated in this type of stricture. The roentgenograms will show a localized area of narrowing with dilation above. Such areas may be congenital or acquired.

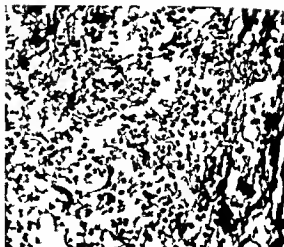


Fig 5. I h o t o m i c o p h f i t k f m t h s a m
t h a t s h n 1 4 L y m p h y t i l t
(X 100)

Wide stricture. In the absence of definite pathological criteria of the so-called wide stricture it is difficult to give a detailed description of the pathological changes involved. Microscopically a stricture may show: (1) changes in the epithelium such as destructions; (2) narrowing of the lumen up to complete obliteration; (3) evidence of inflammatory reaction such as lymphocytic and leukocytic collections in the wall of the ureter; (4) increase in fibrous tissue at the expense of the muscle bundles or an increase of the fibrous tissue normally present and (5) hyalinization of muscle.

In congenital strictures absence of inflammatory reaction will be noted. This may also be noted in the acquired stricture if the process is of long standing. The epithelium may be unchanged in a stricture of moderate degree.

In intrinsic acquired stricture of the ureter the constriction is the result of healing of an injury (used in its widest sense) which has taken place not by resolution but by fibrosis. The fibrosis may be either primary or secondary, the primary taking place without antecedent ulceration, the secondary being the method of healing following ulceration. If sufficient fibrosis occurs following the initial injury and contraction of the fibrous tissue follows, a stricture may result. Localized areas of fibrosis may occur in the wall of the

ureter without as a rule causing diminution of the lumen. These areas of localized fibrosis although possibly indicative of previous infection are not diagnostic of stricture.

In determining any abnormal change in the mucosa, fibrous tissue, or musculature of the ureter, one should first become familiar with the variations that are normally present. In the study of a series of normal ureters microscopically in sections stained by fibrous tissue stains, the large amount of fibrous tissue normally present is apparent. It will vary considerably at the same level in different subjects and in the same ureter at different levels, since it increases in amount over sections nearer the ureteropelvic junction. The width of the mucosa also shows considerable variation at different levels, being much more marked in the upper half of the ureter. Likewise the musculature is variable in different subjects at the same level and in the lower half of the ureter an outer longitudinal muscle layer is visible which is absent in the upper half. In different subjects the musculature may be better developed in one ureter than in the other. In the estimating of any abnormality in the mucosa or increase in fibrous tissue or hypertrophy of muscle, therefore, comparison with normal variations is essential.

In the determining of the degree of obstruction that may be present in a ureter before it should be regarded as due to stricture, several anatomical factors must be considered. As noted, there is a large variation in the size of bulbs that the normal ureter will admit. Recognition of the normal areas of anatomical narrowing is essential. In embryos up to 125 millimeters total length, the ureter is an almost straight tube of even caliber throughout, but slightly later in embryological life three areas of narrowing occur: one at the ureteropelvic junction, the second where the ureter crosses the linea innominata between the true and false pelvis, and the third just above the entrance to the bladder. Among these areas of narrowing, fusiform dilatations may occur: (1) in the lumbar spindle between the first and second narrowings—the lumbar spindle is present in embryos of a little more than 15 millimeters total length and is

abdominal and (2) in the pelvic spindle between the second and third areas of narrowing—the pelvic spindle develops in embryos of 320 millimeters total length, is inconstant, and may be completely lacking after birth. The lumbar enlargement is never absent in embryos of more than 15 millimeters and in children may taper off gradually above and below, in which case the upper and middle narrow parts are only indistinctly seen and the middle may be absent. In most of the cases in the series, these physiological areas of narrowing and the intervening spindles were noted, although in some the pelvic spindle and in others the lumbar spindle was absent. In a few, neither spindle was present.

One cannot conceive of a narrowing sufficient to be labelled stricture without a recognizable increase in fibrous tissue. The converse, however, does not hold. One of us (Braasch) has frequently emphasized the clinical importance of recognizing the existence of inflammatory or atonic dilatation of the ureter. Israel Alksne Andler and other observers have referred to such dilatation as a result of atony. With dilatation of this type, all the changes in the wall of the ureter which occur as the result of stricture may be present except the narrowing of the lumen. Sections of the ureter will then show an increase in fibrous tissue, degeneration of muscle, lymphocytic collections, degeneration of epithelium, and yet may admit with the greatest ease bulbs as large as No. 20 French throughout the length of the ureter.

Small collections of lymphocytes or leucocytes scattered in the wall of the ureter were noted; these were not accompanied by any fibrous or degenerative changes in the surrounding tissues or with constriction of the ureteral lumen. The areas were observed in the different layers of ureteral wall, the majority being situated in the submucosa or musculature. The few areas that were noted in the mucosa did not cause other destructive changes or offer resistance to the passage of a bulb. In the absence of the two essential features of stricture, it is difficult to interpret their presence. Although a collection of lymphocytes often indicates an inflammatory process, it cannot always be so interpreted.

Lymphocytes are frequently observed in various organs in elderly adults and may then be a manifestation of the generalized degenerative process of age. Their presence alone never justifies the diagnosis of stricture even if slight localized fibrotic changes are also present unless there is evidence of destructive changes in the mucosa and narrowing of the lumen.

In this series of 93 necropsies actual stricture of the ureter was found in only two. Neither of these was of an infectious nature; one was the result of extra-ureteral carcinoma and the other was congenital. A so-called wide stricture of inflammatory origin was not found in any of the subjects examined. In the first case there was gross evidence of marked compression of the middle portion of the ureter by metastatic carcinoma with resulting hydro-ureter and hydronephrosis above and a small stone. Microscopic study of the site of the stricture showed (1) increase in fibrous tissue, (2) great narrowing of the lumen, (3) atrophy and replacement of muscle bundles by fibrous tissue, (4) collections of lymphocytes in the wall of the ureter and (5) destruction of the epithelium.

In the second case there was an extremely small ureteral orifice causing obstruction with resultant ureterocele, hydro-ureter and hydronephrosis in the upper segment of a duplicated kidney. The meatus was extremely small and a pointed No. 4 catheter was introduced with difficulty. Serial sections made through the opening did not show an inflammatory process. It seems logical to assume that the partial occlusion of the orifice was the result of congenital stricture.

Besides these two cases there were four teen which showed evidence of renal or ureteral lesions. Among these there were several showing dilatation of the ureter without etiological narrowing of the lumen. One case showed marked ureteritis without stricture; another carcinomatous infiltration of the wall of the ureter causing dilatation of the pelvis. In two male subjects definite pyel ectasis without ureteral obstruction or dilatation was noted and in one subject moderate dilatation of both ureters and pelvis, the latter containing sand. In one female sub

ject (primipara) there was marked dilatation of the upper half of the ureter without any evidence of previous or present inflammation and without stricture. In another female subject (multipara) there was bilateral uretero-pelvic dilatation without stricture. There were four cases of pyelitis and one of suppurative nephritis without any evidence of stricture in the ureter. There were two cases of ureteral stone in which the ureter was normal and did not show evidence of stricture on microscopic study. Thirteen cases showed lymphocytic collections in the wall of the ureter without any increase in fibrous tissue or narrowing of the lumen.

ILLUSTRATIVE CASES

CASE 1. A congenitally small meatus. The patient, aged 55 years (tripara), had suffered from stomach trouble for a year. A history of symptoms referable to the urogenital organs was negative except for nocturia, graded 1. Urine contained pus, graded 1 (4 cells to the high power field). At operation a duodenal ulcer was excised and appendectomy performed. Death was due to pulmonary embolus. The right kidney showed complete duplication of ureter and pelvis. The ureter from the upper pelvis was tremendously dilated as was the pelvis. The meatus was pin point in size and a large ureterocele was present (Fig. 1). Serial sections through the opening did not reveal inflammatory reaction.

CASE 2. True organic stricture caused by pressure of metastasis. The patient, a woman aged 64 years (quintipara), complained of upper lumbar pain, girdle like in distribution and continuous in character. A history of urogenital symptoms was negative. Necropsy revealed carcinoma of the head of the pancreas with multiple areas of metastasis. The kidneys, ureters and bladder were removed intact and a roentgenogram was made (Fig. 2). The right kidney and ureter were normal but the left showed an area of marked narrowing, 16 centimeters from the bladder. Above this area the ureter and pelvis were definitely dilated. There was no obstruction to a No. 19 French catheter in the right ureter and the left ureter admitted a No. 5 French catheter but not a No. 8 French bulb. Above the stricture a small calculus was found. Sections through this area showed a greatly compressed lumen and increase in fibrous tissue. Carcinoma cells were not found in the wall of the ureter although they surrounded it. There were several areas of lymphocytes.

CASE 3. Marked changes in the wall of the ureter without narrowing of the lumen. A man aged 40 years gave a long history of renal lithiasis. Right nephrolithotomy had been performed 3 years previously. He was uremic on admission and died shortly afterward. Necropsy revealed bilateral

pyonephrosis with lithiasis. Both ureters were markedly thickened. The right ureter admitted a No. 20 French olive without obstruction. Sections through this ureter at various levels showed a huge lumen and a very thick ureteral wall with increase in fibrous tissue. The muscle bundles showed degeneration and in part replacement by connective tissue. There was marked infiltration by lymphocytes and leucocytes. The epithelium was retained in part and was squamous in character (Figs. 4 and 5). The left ureter showed obstruction to a No. 13 French olive 8.5 centimeters from the bladder. Sections through this area were similar to those on the right side but with less change.

CASE 4. Ureteral calculi without stricture. A man aged 52 years complained chiefly of angina pectoris. A moderate degree of nocturia had been present. Urinalysis showed pus graded 1 (4 cells to a high power field). At necropsy the ureters and kidneys appeared grossly normal. A calculus was palpated in the left ureter 13 centimeters from the ureteropelvic juncture. The right ureter offered obstruction to a No. 13 French olive 11 centimeters from the bladder and the left 8 centimeters from the bladder. Serial sections from this area in the left ureter did not show abnormality and those from the right showed a few small lymphocytic collections in the fibrous sheath but were otherwise normal.

CASE 5. Obstruction due to interference with peristalsis without decrease in the size of the lumen. A man aged 69 years complained of abdominal pain of 6 months duration. A moderate degree of nocturia had been present for the last 4 years. Urinalysis was practically negative. At necropsy carcinoma of the right suprarenal gland with metastasis to the mesenteric lymph nodes was found. The left renal pelvis showed dilatation graded 2; the right was grossly normal. The left ureter presented obstruction to a No. 17 French olive 10 centimeters from the bladder. Sections at this point and at various other points in the ureter showed marked infiltration of the ureteral wall with carcinoma cells without any increase in the fibrous tissue.

The ureter admitted a No. 16 French olive yet there was dilatation of the pelvis. This case illustrates atony of the ureter from a rare cause—interference with peristalsis from carcinomatous infiltration of the ureter in practically its whole length. This was discovered only on microscopic examination.

CASE 6. Dilatation of the ureter without obstruction. A woman aged 31 years (primipara) complained of symptoms suggestive of brain tumor. There was a history of occasional nocturia; the urine was normal. Necropsy disclosed a malignant neurofibroma. A roentgenogram (Fig. 3) showed dilatation of the upper half of the right ureter. Obstruction to a No. 13 French olive was encountered on the right 1.5 centimeters from the bladder; a No. 17 French olive was not obstructed above this point. On the left there was obstruction 8.5 centimeters from the bladder to a No. 14 French olive.

Sections from the sites of obstruction as well as at the point of dilatation were normal.

SUMMARY AND CONCLUSIONS

1. The incidence of lesions in the ureter is greater than has been previously recognized.

The infectious origin of stricture of the ureter is not so common as recent articles would infer, as is shown by the fact that stricture of this type was not found in 93 necropsies.

3. The caliber of the normal ureter as ascertained by the passage of bulbs varies from No. 8 to No. 20 French.

4. The most frequent site of greatest anatomical narrowing in the normal ureter is in the first 4 centimeters from the ureteral orifice which corresponds to the area in which most strictures have been reported.

5. Lack of symmetry in the two ureters was common. In several instances the caliber of one ureter was 50 per cent greater than that of the other, both being normal on gross and microscopic examination.

6. As the caliber of the lumen of the normal ureter varies, it is difficult to recognize a stricture by means of bulbs or sounds larger than No. 9 French.

7. The demonstration of areas of ureteral dilatation, even when they occur proximal to a portion of the ureter with a comparatively small lumen, does not necessarily indicate stricture. The dilatation in such cases may be atonic and the result of intrinsic cicatricial changes in the wall of the ureter.

8. Microscopic areas of lymphocytic infiltration regarded by some observers as indicative of stricture cannot logically be so classified, since they lack all of the gross and microscopic criteria of stricture.

9. That stricture is not necessary to the formation of renal or ureteral stone is shown by two cases of the series in which evidence of a lesion in the ureter could not be found on gross or serial microscopic section.

10. In at least 8 cases in the series there were some symptoms of urinary disturbance and several in which some tenderness was discovered on palpation of the ureteral area. In none of these could any evidence of ureteral stricture be found.

rr In none of the cases was there evidence of the so called wide stricture. If as has been claimed such strictures are common one must infer that they may exist without leaving any trace of their existence even in microscopic sections of the wall of the ureter.

1 That stricture of the ureter of infectious origin does occur is recognized by everyone. Although the material in this study is inadequate to determine the frequency of its occurrence it nevertheless shows that (1) the incidence of inflammatory stricture is not as great as recent postmortem studies indicate and (2) the diagnosis of stricture by clinical method now employed may be inaccurate.

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BILIARY STASIS AS A FACTOR IN THE PRODUCTION OF GALL STONES¹

LESTER K. WHITAKER, M.D., ROBERT T. N. Y. R.
N. I. R. h. C. I. R. I.

It has long been assumed but never proved beyond question that stasis of bile in the gall bladder leads to the formation of gall stones. However it has been proved as everyone knows that the human gall bladder normally empties almost completely after a heavy meal and then quickly refills. Without perversion of this function how can gall stones be produced?

An attempt to study the effects of stasis has been made by the method of cutting the common bile duct sphincter thus preventing refilling of the gall bladder with fresh bile (1). Masses of what appeared to be inspissated bile were thus produced in the vesicle. They varied in consistency, some were jelly like others were putty like, one resembled a solid cast of the gall bladder. A similar hard cast like structure has since been produced by a somewhat different method (2). Both of these stones were formed in gall bladders in which iodized oil had been placed to allow X-ray observation of their motility.

After repeating the experiment of cutting the common duct sphincter Copher and Iltingworth (3) have concluded that since they obtained no stones when no iodized oil was

placed in the gall bladder the presence of the oil and not the induced stasis is the significant factor in the formation of these stones.

However the first report of the formation of such masses with the iodized oil in the gall bladder also mentioned and illustrated their formation without it. In another cat the sphincter was cut *the gall bladder being undisturbed*. The animal was fed egg yolk and then allowed to fast for several days. The time the viscus was found partly collapsed and filled with a deep green jelly like mass which retained its shape when removed. In a third cat likewise treated the gall bladder contained several smaller soft dark masses suspended in mucus (Fig 9) in a fourth there was a soft stone blocking the cystic duct (Fig 10) in others the gall bladder contained only mucus presumably having emptied itself of bile (1).

Cutting the sphincter of the common bile duct without the injection of iodized oil in 12 additional cases was followed by negative results, the gall bladder being found after several days or weeks to contain only mucus. In these cases there was obviously no stasis.

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of the bile in the gall bladder. The absence of the sphincter prevents refilling of the gall bladder but it does not prevent emptying and evidently the bile remaining in the gall bladder after the operation had been either ejected or displaced by the secretion of mucus. Thus negative experiments may not be of great significance. It is a mistake to assume that because one does not obtain certain results by certain methods such results are unobtainable.

By other methods hard black cast like structures have been produced in cases. While being filled with iodized oil the gall bladder in a cat was accidentally stripped away from the liver nearly down to the cystic duct. It was replaced in its fossa and the abdomen closed. The next day the vesicle had expelled most of the oil excepting flecks adherent to the walls which made the outline visible to the X-ray and had presumably refilled with bile. This shadow form remained constant in spite of feeding for 11 days except that it decreased slowly in size. This perhaps indicates inspissation. At necropsy the gall bladder was found filled with a very hard black cast which bore every appearance of being composed of dehydrated bile. This supposition was strengthened by the finding of a normal mucosa in the vesicle (2). The experiment was repeated several times omitting the injection of the oil but without the expected result.

In another cat the gall bladder was filled with iodized oil and a physiological experiment performed. At the end of this experiment a shadow form similar to that already described was noted signifying a gall bladder containing bile with a little oil about its sides. Steps were then taken to maintain stasis in the vesicle. When the animal was killed days later the expected result was obtained. The neck of the gall bladder and upper cystic duct were filled with a firm cast like structure while the body and fundus (about one half normal size) contained putty like material.

In these cases the iodized oil may have been a factor in the induction of stasis; it may have altered the mucosa in such a manner as to promote inspissation or it may have had other effects. This question is being investigated.

Copher and Illingworth (3) performed a series of experiments in which iodized oil was merely injected into the normal gall bladder and they sometimes found these masses afterward although no stasis was present. They stated that these experiments seemed to indicate clearly that the iodized oil rather than stasis was the important factor in the production of the so called gall stones.

Taking in order from my files 46 records of experiments in which iodized oil was injected into the gall bladder of the cat I obtain some interesting and indecisive figures. In 34 experiments running from 1 to 43 days no masses were found in the gall bladder in 11 experiments running from 1 to 8 days masses were found. The oil may have produced these masses but it was not a very effective producer. However in 46 normal cats in which the gall bladder was examined after feeding experiments masses were never found.

Copher and Illingworth have also suggested that since cholesterol has not been found a constituent of these masses they bear little relation to human gall stones but instead result directly from the presence of iodized oil (3). However it must be remembered that some gall stones contain little if any cholesterol. Furthermore how shall we explain the formation of masses in the gall bladder where no iodized oil has been injected? (1) It is possible that the iodized oil or the operation of introducing it brought about conditions favorable to the formation of these masses but in view of the above facts the conclusion that they result directly from the presence of iodized oil (3) seems unjustified.

Undoubtedly the relation of cholesterol to the formation of gall stones is of prime significance. It has never been claimed that stasis is the only factor in gall stone formation but it is difficult to see how cholesterol could stay long in a gall bladder which contracts normally after meals. The question of the effect of cholesterol in the gall bladder plus stasis has been investigated. In 14 cats cholesterol mixed with bile was placed in the gall bladder and stasis induced by fasting. After 6 days single brownish black masses were formed in the gall bladder in 7 cases. They were 5 to 7 millimeters in the short diameter and rather

oblong one was firm and the other putty like in consistency. In another case there was a small mass of white glistening semi solid material strongly adherent to the mucosa of a gall bladder containing bile stained mucus. In other cases only cholesterol crystals and normal bile were found.

None of these stones has yet been examined chemically. There is a possibility as suggested by Dr Whipple that their basis may be blood clot resulting from the operation. Masses have been found which do look somewhat like blood clot but some of the softer masses when spread out on filter paper produced only a greenish stain. Of course blood clot could hardly be the basis of the masses formed in undisturbed gall bladders.

In the effort however to eliminate as far as possible all factors save stasis and concentration of bile in the gall bladder a new series of experiments was performed. We know that there is at least some stasis in the gall bladder during fasting and of course dehydration should increase the concentration of body fluids. Consequently 9 cats were kept under the influence of barbital sleeping peacefully neither eating nor drinking. Two were negative but in 7 cats which were kept for 5 days to 15 days there were numerous fine particles in the concentrated bile of the gall bladder varying in size from dust to 1 to millimeters and varying in consistency from semi solid to solid. No such particles were found in the gall bladders of the 46 normal cats already mentioned and I do not remember ever having seen them thus though similar particles are often found in the concentrated muddy bile in the gall bladder of patients. No large black masses or casts of the vesicle were produced however in any of these experiments.¹

It has been suggested that intramural infection of the gall bladder may be an etiological factor in gall stone formation (1 2 3). Gall stones have recently been produced by A. L. Wilkie (4) following the intravenous injection of streptococci. Marked thickening of the wall of the gall bladder was induced but the mucosa was often intact. What more probable explanation than that infection of the wall of the gall bladder induced stasis by inhibition of the musculature while concentration continued through the activity of the mucosa resulting in stone formation? (1 2). Attempts are now being made to induce stone formation through damage to the wall of the gall bladder without infection.

Thus it will be seen that the problem is extremely complex and beset with difficulties and uncertainties. However it seems to me that on the whole recent studies confirm the old opinion that stasis is an essential factor in gall stone formation. For instance it has been shown that the human gall bladder normally empties almost completely after meals and also I have found that after feeding the gall bladder of the cat will expel quantities of matter in small particles. It would seem then that stasis which means failure of the expulsive function must be present in order that any material may remain long enough in the gall bladder to be formed into stones. Furthermore as noted above masses can be produced in the gall bladder simply by the physiological induction of stasis.

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CLINICAL SURGERY

FROM THE WOMAN'S HOSPITAL NEW YORK

THE OPERATIVE TECHNIQUE FOR THE REPAIR OF RECTOCELE AND INJURY TO THE PELVIC FLOOR

GEORGE GRAY WARD M.D. F.A.C.S. NEW YORK

A PROPER understanding of the mechanism of the closure of the vaginal orifice is essential in order to appreciate the conditions of impaired function the result of an obstetrical injury which we designate as rectocele and laceration of the pelvic floor. A usual idea is that the closure of the orifice is sphincteric similar to that of the anus while in fact the actual mechanism of the opening and closing of the vaginal introitus is quite different. In teaching we usually compare the mouth and the vaginal orifice.

In the mouth we have a transverse slit with a fixed upper jaw and a movable lower jaw the mouth being closed by the raising of the lower jaw against the upper by the masseter muscles. If these muscles were cut torn or stretched there would result an inability to close the mouth and the lower jaw would hang down.

In the vaginal orifice we have a transverse slit with a fixed anterior and a movable posterior vaginal wall constituting the pelvic floor. The orifice is closed by the raising of the mobile posterior against the immobile anterior segment by the levator muscle as in the mouth and not by a sphincteric action in spite of the so called sphincter vaginae muscle.

Ramifications of the pelvic fascia give support and strength to the levator in the vaginal sulci where it is ruptured by the advancing fetal head when it receives the brunt of the strain during the internal rotation in labor or is torn frequently in both sulci by the forceps blades. A condition then produced is similar to a rupture of the fascia lata of the thigh when the strain in standing would fall upon the quadriceps extensor with resulting tire and ultimate stretching of that muscle. The torn pelvic fascia allows the strain to fall upon the anterior fibers of the levator torn away from its lateral attachments to the rectum and the perineal body into which the fibers of each muscle decussate. The consequence is ultimate stretching and relaxation while the result

is that the posterior segment of the pelvic floor is not properly lifted because of the elongated or torn levator fibers. The vaginal mouth therefore is constantly gaping and the unsupported vaginal walls with their attached viscera tend to roll down and out. The strength and support of the posterior vaginal wall and rectum reside in the firm barrier formed by the fusion of the two layers of the levator fascia the fascia of the urogenital diaphragm and Colles fascia at the site of the perineum. Should this fascial support of the posterior vaginal wall and rectum be injured the open vaginal mouth then favors the protrusion or hernia of the anterior rectal wall at the site of the injury designated a rectocele. Such an anatomical change alters the normal mechanism of defecation by diverting the direction of the fecal current so that the anterior rectal and the posterior vaginal wall receive the brunt of the strain with a consequent protrusion which increases until a distinct rectal pouch forms and renders complete evacuation difficult.

Conditions in a rectocele are similar to cystocele. Both are due to an injury of the fascial supports and their development is accelerated by the patent vaginal orifice following the pelvic floor injury.

In the past the operation advocated to cure cystocele and rectocele was the shutting of the vaginal mouth by an operation based on the Emmet principle and the taking up of the slack or excess of vaginal tissue by a superficial denudation of the mucosa and the approximation of the edges. This apparently produced a good immediate result but the prolapsed bladder and rectum were simply thrown into folds which the daily exercise of their functions soon obliterated and the results were evanescent.

In recent years the cystocele problem has been well worked out. B. E. Hadra first and then M. Saenger urged a more radical procedure to insure permanency and showed that the bladder must be

completely separated from the vaginal wall as well as the uterus and shifted to a higher plane in the pelvis and that the fascial opening must be repaired and finally the excess of the vaginal wall resected.

In rectocele we have a true hernia or prolapsus of the rectum perfectly analogous to cystocele. The bowel also becomes enlarged and pouched until there is an increase in the size of the gut similar to that of the bladder in cystocele.

It is obvious that as a rectocele parallels cystocele we ought to apply the identical principle which has proved so successful in vesical prolapse and this we have done with uniform success for many years.

The operation consists in the complete separation of rectum and posterior vaginal wall as far up as the cul de sac of Douglas the sliding of the loosened rectal pouch high up along the vaginal wall the fastening of it there with a suture and closure of the fascial opening. By this the denuded rectum is drawn up and secured and made to adhere to the upper undamaged posterior vaginal wall well above the site of the former rectocele. This procedure we have designated as a rectopexy.

A perineorrhaphy follows in the form of a muscle operation. By approximating the anterior levator fibers the muscle barrier thus formed acts as a dam to prevent the recurrence of the rectocele in addition to furnishing an effective restoration of the vaginal orifice. The perineorrhaphy described has been done in its essentials by the author since May 1908 with slight modifications from time to time.

When we recall the normal decussation of the anterior fibers of both levators in the perineum any objection to this type of operation as anatomically incorrect is not valid.

The improved technique as we now do the operation at our clinic at the Woman's Hospital is as follows:

The labia minora are drawn out of the way and sutured to the skin. A gauze sponge on a sponge holder is inserted in the rectum as a guide. The introitus is opened wide with a Friedman retractor which catches each posterior caruncle just below the orifices of Bartholin's glands care being taken not to occlude them. A third forceps is attached to the posterior vaginal wall in the median line marking the crest of the rectocele. While traction is made on these tenacula the resulting triangle is outlined with a scalpel. This area represents the excess vaginal wall to be removed subsequently the marking of its bound-

aries at the outset greatly facilitates its accurate removal as a later step (Fig. 1).

With blunt scissors the base of the triangle is dissected free from side to side and the superficial and fused fascial structures cut through. By blunt dissection the gauze covered finger opens up the line of cleavage between the side of the rectum and the levator muscle in each sulcus the finger penetrating deeply between the muscle and its superior layer of fascia which is also attached to the rectum and the under surface of the vaginal sulcus. This dissection ought freely to expose the anterior fibers of the levator as well as its superior surface (Fig. 2).

The rectum is next separated from the posterior vaginal wall well above the area of the vagina outlined for removal by the insertion and pushing up the line of cleavage of closed blunt pointed scissors which are then opened wide and with drawn while open. The sponge and forceps in the rectum furnish a guide as to the path of safety. A wide space is thus opened up between the rectum and vagina well above the site of the rectocele (Fig. 3).

The levators are now freely exposed and the rectum separated from the vagina the layer of pelvic fascia covering the superior surfaces of the levators (rectovesical fascia) and attached to the sides of the rectum and to the under surface of the vaginal sulci upon separation from the muscle forms partitions which divide the dissected area into three spaces. Curved clamps are placed on these fascial partitions close under the vaginal wall extending upward about 15 centimeters and the fascia severed from its vaginal attachments (Fig. 4).

A No. 2 tanned catgut suture is passed through the vaginal wall in the midline well above the site of the rectocele is brought down between vagina and rectum and passed through the lower margins of the fascial stumps grasped by the clamps and returns to pass back through the vaginal wall near the first point of entrance.

When this suture is tightened and tied it obviously draws the mobile rectum upward well beyond the limit of the subsequent resection of the vagina. Thus the denuded rectum is carried up and placed where it will adhere firmly to the upper undamaged third of the posterior vagina above the former site of the rectocele. We designate this procedure as rectopexy (Fig. 5).

The dilated part of the vaginal wall which entered into the formation of the rectocele is then cut away along the lines of the incision outlined at the beginning of the operation (Fig. 6) and the cut edges of the vagina are sutured with

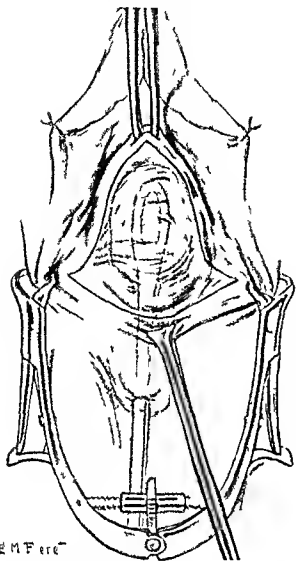


Fig. 2. Sponge in rectum outlines rectocele. Friedman retractor opens introitus widely exposing vaginal sulcus. Triangular area of vaginal wall which is to be removed is outlined with a scalpel.

interrupted tanned catgut sutures taking care to include the two fascial stumps in the upper sutures so as to insure the closure of the space between them (Fig. 7).

The anterior margins of the levators are then grasped with sponge forceps drawn toward the midline (Fig. 8) and sutured together with interrupted catgut sutures (Fig. 9A). The effect of this approximation of the levators is immediately apparent: the shortening of the muscles lifting up the relaxed pelvic floor and forming a strong barrier to further descent of the rectum.

Care must be taken not to overcorrect the elongation of the levators by placing the approximation sutures too high. Criticism is sometimes made against this type of operation that it produces an objectional band across the introitus

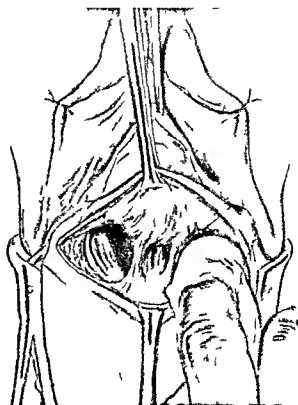


Fig. 4. Superficial and fused fascial structures cut through and levator muscle and rectum separated in each sulcus by blunt dissection with gauze and finger. Anterior fibers of levator freely exposed.

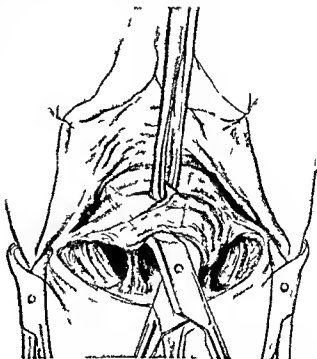
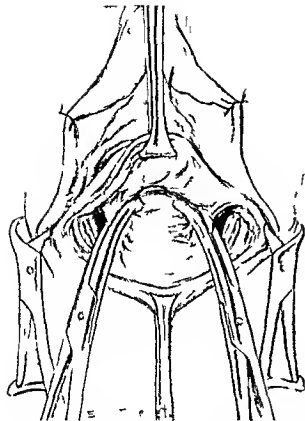
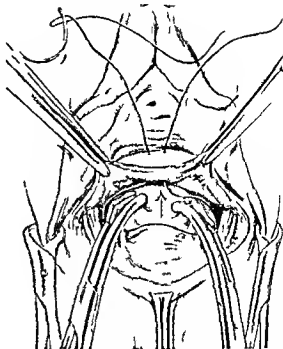


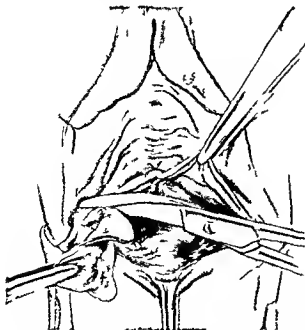
Fig. 3. Rectum separated from vaginal wall well above area outlined for removal. Blunt pointed angular scissors inserted in line of cleavage while closed then opened widely and withdrawn while open. Sponge forceps in rectum as guide to the path of safety.



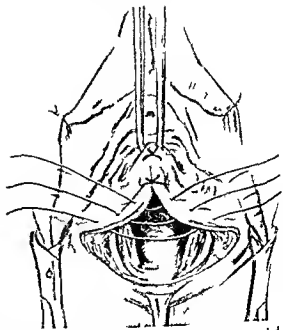
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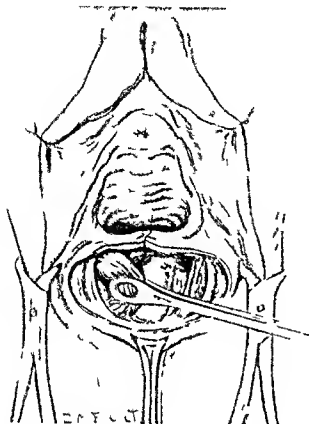


FIG. 8. Anterior margins of levators separated with sharp forceps and drawn toward midline.

which may be tender and troublesome. If the operation is properly done there will be no such criticism as it is always an indication of over correction. It must not be forgotten that the complete relaxation of the muscles due to anaesthesia is not the condition existing when the muscles have regained their full tone.

The sharp edge of Colles' fascia on each side of the wound close to the united levators is sutured with a continuous No. 1 tanned catgut suture. At its origin this suture is passed wide and deep to unite the fused fascial structures of the urogenital diaphragm, levator fascia and Colles' fascia. It also catches up the united levator

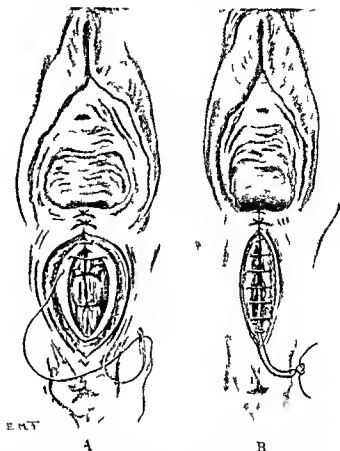


FIG. 9. A. Levators sutured to ether with interrupted catgut sutures. Sharp edge of Colles' fascia seen on each side of wound and not sutured with continuous suture which at its origin is passed wide and deep to include fused fascial structures at this point. Suture also catches united levators. B. Skin margin then closed with a subcuticular tanned catgut suture and end tied to fascial stitch. The knot disappears between margins of the incision.

muscles and is half hitched at its termination and left long to tie to the subcuticular suture (Fig. 9A).

The skin margin is then closed with a subcuticular suture of No. 1 tanned catgut on a fine needle and the end tied to the fascial stitch (Fig. 9B). The knot disappears between the edges of the incision.

FROM THE UROLOGIC CLINIC PRESBYTERIAN HOSPITAL

DIVERTICULUM OF THE BLADDER

HERMAN I. KRITSCHNER, M.D., F.A.C.S. CHICAGO

DIVERTICULUM of the urinary bladder is a condition which until comparatively recent years has received but little if any clinical recognition in spite of the fact that the condition has been known and recognized for many years. Morgagni (1683-1771) was one of the early writers and probably the first to recognize its true nature. Honstet, Bonet, Tenon and Choquet were also early writers on the subject. Up to 1906 only 5 cases had been reported in the literature of the United States. The scarcity of case reports was not due to the fact that the condition was not known but to the fact that the special instruments necessary for its diagnosis were not available. Today with the perfection of the cystoscope, the use of the roentgen ray and the more widespread use of cystograms, diverticulum of the bladder is recognized by careful investigators; hence the number of patients operated upon has greatly increased as has likewise the number of cases reported in the literature.

In the diagnosis of the diverticula, four procedures may be used: (1) cystoscopy, (2) cystography, (3) contrast cystograms and (4) the utilization of the ureteral catheter in the diverticulum.

In every case in which the patient has residual urine either with or without infection the possibility of a diverticulum should always be thought of during cystoscopic examination. When the opening of the diverticulum is large it can readily be recognized with the cystoscope. But in the presence of a severe cystitis a diverticulum may be overlooked. Cystography often reveals the presence of an overlooked diverticulum. Cystograms should be made in two diameters and there is no objection to making stereoscopic roentgenograms. To determine the size of the diverticulum a ureteral catheter may be coiled up in the sac, the sac injected with bromide solution and the bladder cavity injected with air.

Small cellulæ or saccules call for no special treatment. It is always best to remember that the presence of a diverticulum means obstruction and that when the obstruction is removed these small diverticula cause no further trouble. The larger diverticula, however, call for surgical re-

moval by complete excision, nothing short of this must be done if permanent relief is to be attained.

Two methods of removal are in use: the extravesical and intravesical.

Since a diverticulum is always associated with obstruction and since a certain degree of infection is frequently present, preliminary treatment may be indicated. At times an indwelling urethral catheter may be used and daily bladder irrigations instituted. Silver nitrate or potassium permanganate are drugs commonly used for this purpose. I have repeatedly seen an appreciable diminution in the size of a diverticulum under catheter drainage of the bladder.

A two stage operation may be done. At the first operation suprapubic drainage is instituted and at the second operation the diverticulum and the obstruction are removed. Some surgeons advise stretching the neck of the diverticulum and in the drainage of the sac and recommending that this be done at the time that suprapubic drainage is instituted. The importance of clearing up the infection cannot be overemphasized.

In view of the fact that diverticula are often associated with residual urine and infection, a very careful study of the renal function should be made and operation should not be attempted until function has become stabilized.

The operation may be begun with local anesthesia which is followed by some form of inhalation anesthesia.

A median suprapubic incision is made through which the bladder is exposed and as much of the peritoneum as necessary dissected from the bladder depending upon the location of the diverticulum. The bladder is opened with a wide incision to insure a good view of the inside. The bladder is carefully inspected to locate any diverticula which may have been overlooked with the cystoscope. At this time one may decide upon either the extravesical or intravesical method of resection.

EXTRAVESICAL RESECTION

The opening of the diverticulum is brought into view and the cavity packed tightly with a gauze strip 2 inches wide. This converts the sac into a semisolid tumor and makes the dissection

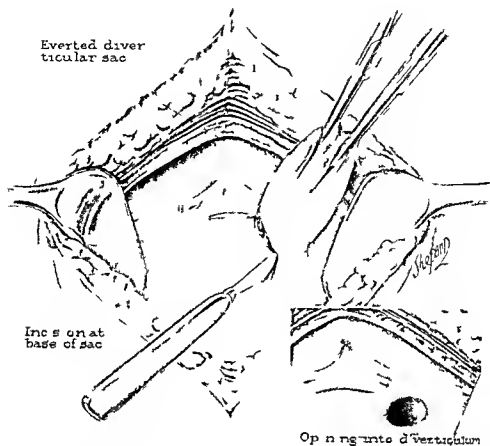


Fig. 1. The sac has been everted by means of artery forceps and an incision made at the base of the sac. The insert shows the opening of the diverticulum near the right ureteral orifice.

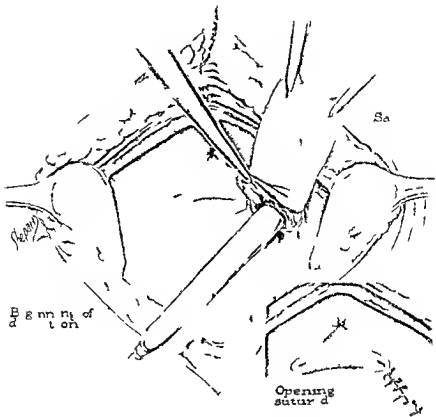
of the sac outside the bladder down to the neck, a relatively simple procedure. The sac is severed at its attachment to the bladder and the resulting opening closed with catgut sutures. It is most important that this closure be made with good firm apposition of the muscular wall. A drain is carried down to the suture line and the bladder closed in the usual way. As far as I know, Lower was the first to pack the diverticulum with gauze as an aid in its removal.

INTRAVESICAL DIVERTICULECTOMY

Whether one does an intravesical or an extravesical diverticulectomy is merely a matter of choice. I have always used the intravesical method. After the bladder has been opened and the diverticulum located the next step is the intravesical eversion of the sac. The sac may be everted by suction—as advocated by Young—or by means of artery clamps. I have always preferred the use of clamps. If small the opening of the diverticulum may be enlarged by dilatation

with forceps. The sac is then grasped with clamps and gradually everted. After the inversion it is well to determine again its exact relationship to the ureter. A circular incision is made around the neck of the sac after which the sac is separated by blunt dissection with a gauze sponge or the handle of a scalpel. At this stage large vessels may be encountered; they should be clamped and ligated.

The opening in the bladder is closed with a row of catgut sutures placed on the inside of the bladder. The resulting cavity outside the bladder is drained with a cigarette drain and the bladder closed in the usual way around a suprapubic drain. When the ureter opens into the sac or is situated at the margin the incision along the neck of the diverticulum should be made at a safe distance from the ureteral orifice so as to avoid injury to the closing mechanism of the ureter. During the dissection of the sac great care should be exercised to avoid injury to the ureter itself and to safeguard against any possible



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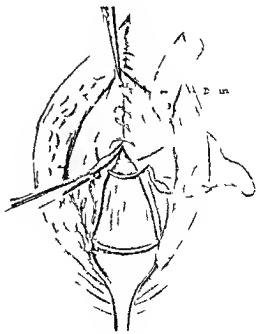


Fig 4 Cl f l b l d d t l g t t h

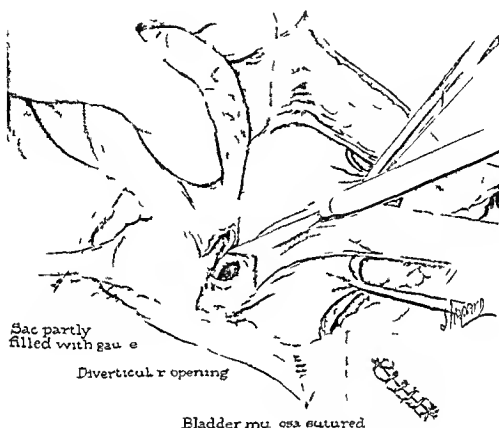


Fig 5 Transvesical removal of the diverticulum. The sac has been partly filled with gauze to aid in the dissection.

injury during the dissection a ureteral catheter may first be passed up the ureter.

The treatment of the obstructing lesion whether by prostatectomy, resection or by a median bar punch must not be overlooked and can be done at the same time or at a later date.

The removal of the suprapubic catheter or drain depends upon the degree of infection still present and the rapidity with which it clears up. As a rule it can be removed on the third day after operation at which time an indwelling catheter is placed in the urethra.

TUBERCULOSIS OF THE CERVIX UTERI

WITH A REPORT OF TWO CASES ONE PROBABLY PRIMARY IN THE CERVIX

MARION DOUGLASS M.D. AND MAGNUS PIDLON M.D. CLEVELAND O. IO

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TUBERCULOSIS of the cervix uteri is a rare lesion. It occurs in probably no more than 3 or 4 per cent (Kelly) of cases of pelvic tuberculosis. It has been suggested that this immunity is due to the tissue resistance of the stratified squamous epithelium of the vaginal portion of the cervix and also to the bactericidal quality of the cervical secretion which Menge was unable to infect with various pathogenic organisms. Tubercle bacilli have never been demonstrated in vaginal secretions.

Tuberculous disease of the cervix was originally described by Raymond in 1831 and Virchow reported a case in 1853; since then a scanty literature has accumulated. Moore stated in 1919 that approximately 20 cases of primary and 150 of secondary tuberculous lesions of the cervix had been reported and that Fden Lockyer and Williams had found that one of 600 women with pulmonary tuberculosis had tuberculosis of the cervix.

Involvement of the cervix with tuberculosis is either a bloodstream infection or is an ascending infection from a primary genital lesion. Primary infection of the cervix has been found in women whose husbands had pulmonary tuberculosis; the infection taking place both by genital contamination through tuberculous sputum, infection of hands, etc., and by transmission of the tubercle bacilli from a tuberculous epididymitis. It has been fairly well established that tubercle bacilli may pass through normal capillary membranes; hence genital infection is possible in the female from a male with pulmonary tuberculosis but without demonstrable genital lesion. There is sufficient evidence to make us believe that many cases of genital tuberculosis in women are transmitted by coitus. Anatomically tuberculous lesions of the cervix have been classified as miliary, interstitial, pyramidal and ulcerative. In the majority of early cases the lesion is hypertrophic, proliferative or vegetative in type, whereas in the more advanced stages true tubercle formation and ulceration with loss of tissue is a pronounced feature.

It seems likely that anatomical classifications are really descriptive of varying stages of the same pathological process. Microscopically there is tremendous variation in the picture, there being

hyperplasia of the glands, granulation tissue development and caseation all occurring in various portions in the same section. Giant cells vary in number as well as do typical tubercles and the irregularity of the glands, particularly in the early stages, produces some resemblance to carcinoma. There is normally little difficulty about making a diagnosis by microscopic examination, but grossly the picture is often confusing and the symptoms are extremely variable and indefinite. Malaise and occasionally fever occur. Amenorrhoea has been reported as a symptom in approximately 50 per cent of the cases and leucorrhoea is a common early symptom. Slight bleeding after coitus is common, but blood stained purulent discharge has been described as a typical finding in contrast to the more watery discharge of carcinoma. In tuberculosis tissues tend to be softer than in carcinoma, lacking friability, but sometimes the tissues are extremely tough during stages of extreme infiltration. The ulceration and firm fixation of the cervix, however, are very suggestive of cervical neoplasm and cases are almost certain to be mistaken for carcinoma on pelvic examination, even with the most careful inspection when happened in our first case (Case 1). Recently two cases have come under our observation.

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Fig 1 Case 1 No 117492 Photomicrograph showing ulceration and degeneration near the edge of the cervix where well preserved epithelium is seen. Numerous giant cells are seen in typical tuberculous granulation tissue.



Fig 2 Case 2 No 122704 Photomicrograph showing tuberculous granulation tissue with giant cells and well-marked tubercle formation showing also the remains of a cervical gland. Tubercle formation is the feature of the histological picture in this case as compared to the other. Although tubercle bacilli could not be demonstrated in the tissue the diagnosis of tuberculosis is justified on histological grounds.

matory character of the lesion surgical removal seemed to be the method of choice.

Operation. When the abdomen was opened relatively few but very tough adhesions were found binding down both tubes and ovaries. Total hysterectomy was performed the tubes and ovaries being removed (Fig 3). The uterus contained a single intramural fibroid the size of a hen's egg. The myometrium was fibrotic. On the surface of the uterus there was evidence of partially organized edematous red masses varying in size up to 1 centimeter in diameter. The consistency of the tissue was firm and rubbery, not hard or friable. The endometrium was smooth and uniform. There were no gross abnormalities. The right ovary was small, necrotic and covered by fibrous adhesions. The other ovary was similar in appearance and contained a small corpus luteum. The cyst contained a small circumscribed white caseous area in the center. The tubes were scaled off thickened and covered with fibrous adhesions. Their surface was studded with small white tubercular nodules.

Histological analysis. In certain areas of the section there was marked hyperplasia of the cervical gland with typical Nabothian cyst formation elsewhere there was diffuse round cell infiltration, central necrosis and typical tubercle formation (Fig 1). The cervix presented a picture of diffuse infiltration with disappearance of the uterine gland, a few remnants of which could be seen. There were numerous clumps of round cells forming typical tuberculous granulation tissue. The tubes contained tubercles and giant cells. There was almost complete disappearance of the placental roundness the lumen of the tubes the epithelium of which was intact in some places.

The patient made an uninterrupted recovery and has remained in good health over a period of 2 years.

CASE. Mrs E C colored aged 22 years a nullipara. This patient was admitted to the hospital on January 4, 1928 complaining of amenorrhea and headache of several weeks duration. Leucorrhoea was a marked symptom. No bleeding was observed at examination. Vaginal examination revealed a normal outlet. There were several venereal diseases on the vulva. The cervix was irregularly ulcerated.



Fig 3 Case 1 No 117492 Specimen obtained at hysterectomy. Both tubes are studded with white tubercular nodules.

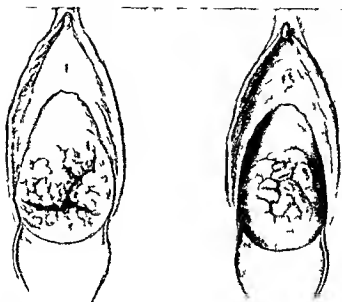


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CHARACTER OF LESIONS

When freed from superficial discharge these lesions present a picture which is at once ulcerative and proliferative in character. It suggests the vegetative form (*vegetante neoplasique*) but nevertheless is not truly fungating or cauliflower like. Ulceration and necrosis with profuse bleeding were present in a marked degree in Case 1 and the gross appearance is best described as geographical, the firm elevations of tissue separated by sulci.

The uterine cavity could be explored easily by a large sound the external os presentin as an irregular laceration formed by the intersection of three deep defects (Fig 4). The extreme dark red beefy color of carcinoma was absent. The relative elasticity in the texture of the lesion is of value as a diagnostic sign. Although having an ulcerative lesion of advanced grade with crater formation at the time of examination there was no history of bleeding and no blood was seen at examination (Case 2). The histological picture of tuberculosis is not always clear cut and typical tubercle formation is sometimes difficult to demonstrate in the picture of chronic infiltrative inflammatory disease.

TREATMENT

The form of the treatment depends upon whether the cervical lesion is primary or secondary. If the lesion can be definitely proved primary surgery is indicated. We believe that pan-hysterectomy by the abdominal route is the best procedure even if only a slight lesion is present for by this method we are able to examine the pelvic viscera more closely for tuberculous lesions. If the vagina is involved its extirpation may be necessary (Jellett). Amputation of the cervix is advised perhaps only as a palliative measure in those cases in which for any reason more radical surgery is contra-indicated.

If the lesion is secondary to advanced tuberculosis elsewhere only palliative measures are indicated. Cauterization may give some relief from discharge. Astringent douches may be helpful as tannic acid and zinc sulphate. Radium therapy may be used to some advantage but is absolutely contra-indicated if salpingitis is present (Jellett, Norris).

The general care of the patient is very important. It is advisable to treat a primary case promptly since in any tuberculous patient the resistance is lowered to acid fast organisms and generalized systemic tuberculosis may follow.

The prognosis is good in primary cases. In secondary cases the prognosis depends upon the severity of the general infection. If the original lesion can be improved by general measures the secondary infection will likewise have a greater chance of improvement.

SUMMARY

Tuberculosis of the cervix uteri is an extremely infrequent gynecological lesion. Less than 20 cases of undoubtedly primary tuberculous lesions in the cervix have been recorded. Secondary involvement of the cervix is much more frequent and the prognosis is less favorable depending upon the severity of the associated tuberculous foci. Two cases are presented: one of paratuberculosis of the pelvic viscera and a second a presumable case of primary tuberculosis of the cervix based on the evidence so far obtained. Complete recovery of the patient followed pan-hysterectomy in the first case.

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OSTEOPLASTIC RESECTION OF COSTAL ARCH FOR
GUNSHOT WOUND OF SPLEEN¹

HERBERT WILLI MEYER MB MD FACS NEW YORK

A social A d g S g Th Le Ill Hospital As A d m S g N w Y k k I C H p l

A VERY important principle of surgery is the development of a simple and readily accessible operative field.

During the night of May 8, 1927 I had to perform a splenectomy for an uncontrollable hæmorrhage from a gunshot wound of the posterior border of the spleen.² In order to gain proper access I was forced to do an osteoplastic resection of the left costal arch. This procedure afforded such excellent opportunity to do careful surgery up under the vault of the diaphragm in the presence of active bleeding that I decided to report the case in order to bring the principle again to the attention of other surgeons.

In 1906 my father Dr. Willy Meyer (3) published an article on the Osteoplastic Resection of the Costal Arch in Order to Reach the Vault of the Diaphragm. He reported two cases in which he had performed osteoplastic resection of the costal arch. One was a case of an impermeable stricture of the lowest end of the œsophagus in a boy 14 years old. An attempt was made to reach the strictured area. A year later 1905, he performed a splenectomy for a large sarcoma of the spleen in which the same technique was employed.

In 1904 I had the good fortune and opportunity to assist my father in performing one of these operations. It was for an inoperable carcinoma of the pylorus with total obstruction. In order to make an anterior gastro-enterostomy with Murphy button anastomosis near the cardia it was necessary to turn up the costal arch. Access was so perfect and convalescence so smooth that I was impressed with the great value of the procedure.

G. Marwedel (2) in 1903 was the first to publish an article describing the osteoplastic resection of the distal arch. Von Michulicz has previously performed an operation on the same principle to gain better access but the technique was much more complicated than that in the procedure of Marwedel. Following Marwedel's publication Asthøwer (1) wrote an article in which he stated that he had used a similar technique a number of

times the earliest instances being in 1894. Wiener (4) reported a case operated upon in 1908 in which he did an osteoplastic resection of the costal arch in a case of carcinoma of the cardia.

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Fig 1 Roentgenogram showing one bullet lying on the first rib in front of transverse process of the seventh cervical vertebra and second bullet in the soft parts of the left pectoral region with fracture of the left clavicle

Immediate exploratory laparotomy was indicated with a provisional diagnosis of rupture of the spleen

A left pararectal incision about 4 inches long was made close to the mid line. The peritoneal cavity was entered. No free fluid was present. When the left lumbar gutter and subdiaphragmatic space were explored a large amount of blood escaped. The spleen was palpated and was found to be small in size, high up under the vault of the diaphragm. A large tear was felt along the posterior border. Therefore a transverse incision was made at right angles to the previous incision outward to the tip of the eleventh rib. With strong retraction on the costal margin it was found impossible to visualize the splenic hilus clearly on account of its high position under the vault of the diaphragm and the presence of a very much distended stomach (the patient had been eating and drinking heavily all evening). It was found that when the spleen was pulled downward and mesially bleeding from the tear ceased, but when it was relaxed it bled freely again. Proper suture or tamponade of the tear on account of its inaccessibility was impossible, the tear being along the posterior border. Therefore splenectomy was considered the best and safest procedure. However, access to the hilus of the small spleen which could not be sufficiently displaced downward was very poor. Osteoplastic resection of the costal arch offered an outlook of material aid to obtain a proper operative field.

OSTEOPLASTIC RESECTION OF THE COSTAL ARCH

The incision is lengthened upward to the level of the junction of the costal arch with the manubrium (Fig 4). The line of cleavage between the posterior surface of the rectus muscle and its

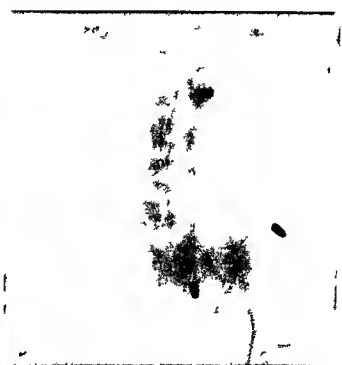


Fig 2 Roentgenogram showing bullet in left lumbar region. This could be palpated subcutaneously. Also fracture of the twelfth rib with two other bullets in the soft parts of the sacral and gluteal regions



Fig 3 More detailed roentgenogram of the fracture of the twelfth rib with the bullet and fragments of lead in the bullet tract

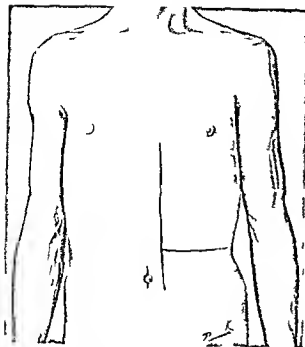


Fig. 4. D. r. m. t. k. t. l. h. w. g. a. b. d. m. n. l. t. h. w. d. t. m. d. h. t. g. l. t. f. j. u. t. o. f. t. l. h. t. t. f. l. t. l. i. o. t. a. d.

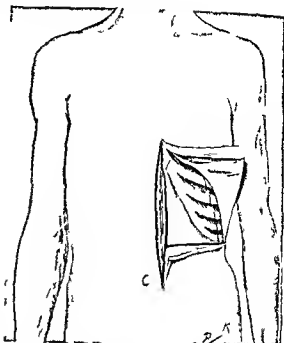


Fig. 5. D. g. m. m. a. t. k. e. t. h. h. e. p. e. d. c. t. l. h. t. h. d. t. l. f. t. h. j. e. d. r. t. l. t. h. m. b. m. d. t. h. t. f. t. h. l. a. t. l. g. o. f. t. h. e. t. t. t. h. b. S. k. a. n. d. m. l. f. l. p. d. t. d. p. r. d. d. u. t. d.

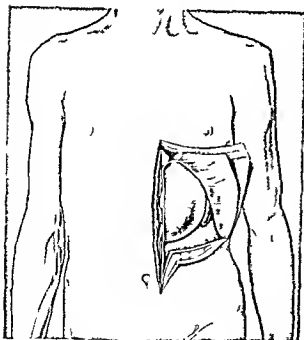


Fig. 6. D. m. m. t. k. e. t. l. h. w. g. k. i. d. m. l. f. p. d. t. l. b. w. t. p. e. t. o. m. t. m. e. d. p. g. i. l. t. e. p. u. f. t. h. g. a. s. l. y. m. o. m. t. h. e. a. l. t. o. f. t. h. d. p. h. a. m.

posterior sheath is found. This skin muscle flap is then gently pushed upward and outward thus exposing the entire costal arch with the junction of the cartilages and the bony ribs.

With a sharp scalpel and great care not to injure the underlying pleura the joined cartilage of the seventh, eighth and ninth ribs, completely divided near the manubrium. Care must be taken not to injure the internal mammary vessels which lie just beneath. Then the outer ends of the seventh to tenth costal cartilages are also carefully completely divided close to the bony ribs. Sometimes it is necessary to divide a cartilaginous connection between the sixth and seventh cartilages. The procedure thus mobilizes the costal arch (Fig. 5). The skin muscle flap is then turned back and the entire resulting skin muscle costal arch and peritoneal flap is turned up and retracted outward by the assistant's hand (Fig. 6).

Immediately perfect exposure of the entire under surface of the diaphragm, the cardia of the stomach and the spleen is obtained.

The actual splenectomy is now exceedingly safe and simple. The phrenicohepatic ligament can easily be ligated and divided, as well as an accessory vessel which runs to the lower pole of the spleen. The gastro-splenic vessels are easily



Fig 7 Photograph of the spleen showing tear along the posterior border caused by the bullet

divided and the main pedicle clamped divided and doubly ligated

After the spleen had been removed in our patient the entrance wound of the bullet through the diaphragm could be seen as well as the wound of exit at the level of the twelfth rib posteriorly (Fig 7) On account of the potential infection of the subphrenic space by the bullet drains were inserted The costal arch was then turned down again and a most careful suture of the abdominal wall was performed with interrupted chromic catgut in layers peritoneum muscle and aponeurosis The superficial wound was sutured with silkworm gut and interrupted silk A firm adhesive strapping dressing was applied

Convalescence was stormy The patient was cyanotic on the second postoperative day and bronchovesicular breathing could be heard especially at the left base posteriorly Bedside X ray examination showed a small pneumothorax Temperature was 103 degrees On the seventh postoperative day the wound looked clean and the skin sutures were removed The pneumothorax had abated but loud bronchial breathing could be heard over the left base Physical examination revealed no pleural effusion The patient coughed severely A moderate seropurulent discharge issued from the drainage tract of the abdominal wound On the eighth day after operation patient had a coughing spell which caused the entire per rectal portion of the wound to break open and the stomach and omentum to extrude Cultures were made from the wound and staphylococcus albus was found in pure culture (probably carried in by the bullet) The viscera were replaced while the patient remained in bed and the wound edges were approximated with wide adhesive straps Three weeks after the operation the temperature again began to rise and evidence of pleural exudation in the axillary line was found Fifty cubic centimeters of slightly turbid fluid was withdrawn with the Potam aspirating apparatus and cultures were reported to be sterile

After 3 additional weeks with 10 days of intervening normal temperature the bullet from the cervical region was removed The bullet was found in an encapsulated



Fig 8 Photograph of the patient taken 6 months after the operation showing healed scar with firm union of the costal arch

abscess cavity within the scalenus medius muscle The pus from this abscess also showed staphylococcus albus in pure culture as did the pus from the abdominal wound After this bullet was removed all the neurological findings of the left arm as found by Dr Russell MacRobert quickly improved—local area of anesthesia in the left forearm and hand of radial distribution with motor disability which corresponded to the first thoracic segmental supply

Two weeks later the three remaining bullets were removed from the back sacral and gluteal regions under local anesthesia The bullet in the pectoral region lying just in the wound of emergence was removed at the time of the original operation

The patient was discharged on the forty third day with all the wounds healed

At present there is evidence of weakness of the vertical portion of the scar where the wound had broken open No actual hernia has occurred but the patient is wearing an abdominal supporter The costal arch has firmly united with the ribs The pain anesthesia and mobility of the left arm have entirely improved (Fig 8)

CONCLUSIONS

Osteoplastic or more properly called chondroplastic resection of the costal arch is a great help in obtaining a good simple safe operative field in certain operations under the vault of the

diaphragm in diaphragmatic hernia and in operations on the liver the spleen and the stomach near the cardia

The procedure is simple quickly performed and safe if done with the usual care always necessary in surgery

The attachments of the diaphragm are not disturbed or interfered with

The procedure justified itself as it affords excellent access to the subdiaphragmatic space The final cosmetic and functional result is good and union of the costal arch is firm The author begs to bring the procedure to the earnest attention of other surgeons

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FOUR SPLINTS OF VALUE IN THE TREATMENT OF DISABILITIES OF THE HAND

SUMNER L KOCH M D F A C S CHICAGO

F m h s g 15 { D All B k t d s m L Koch W t y M m 1 H p l

FOR many years Kanavel has emphasized the importance of properly designed splints¹ and of physical therapy for the prevention and correction of contractures following infections and injuries of the hand Two principles have been particularly emphasized the maintenance of the hand in the position of function during the period of forced immobilization and the use of elastic tension to produce constant and painless traction² on fibrosed soft tissues and contracted joint capsules When one observes how quickly the relaxation and mobility of contracted fingers and joints gained by a half hour or an hour of physical therapy is lost because of the lack of any form of retentive apparatus he is doubly impressed with the importance of careful splinting in the treatment of contractures

Four splints have gradually been developed in our work which have proved of great value in the carrying out of the principles mentioned All are light in weight fairly rigid and made of hard flat aluminum No SH o8r inch in thickness The first (Fig 1 a b) is designed to maintain the hand in the position of function i e with the wrist

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dorsiflexed the thumb abducted from the hand and facing the fingers and the fingers semiflexed as though grasping a tennis ball The splint is curved in its long axis so as to fit snugly to the volar surface of the forearm it is slightly curved in a transverse axis just distal to the wrist so as to fit the heel of the hand Pressure on the thenar eminence is eliminated by the cutting out of a rounded portion on the radial side Dorsal flexion is regulated by the degree of flexion of the splint at the wrist The lower rounded end of the splint separates the thumb from the fingers but stops short of the metacarpophalangeal articulations so as to permit flexion of the fingers at these joints the joints most often held immobilized after infection and injury and as a result most often involved in fibrous contractures

Such a splint can be padded with washable feather edge rubber or with felt (Fig 1 c d) it can be applied to the hand while infection is still present as soon as it is possible to substitute intermittent hot wet dressings for a continuous wet dressin—usually within 4 or 5 days of the onset of even a serious infection If padded straps with buckles are attached to the splint it can be quickly taken off and reapplied—important factors if one is caring for a considerable number of patients or is treating patients who are not particularly interested in getting well quickly and therefore tend to neglect the treatment indicated

The second splint (Fig 2) is similar to the first with the addition of a raised aluminum crosspiece

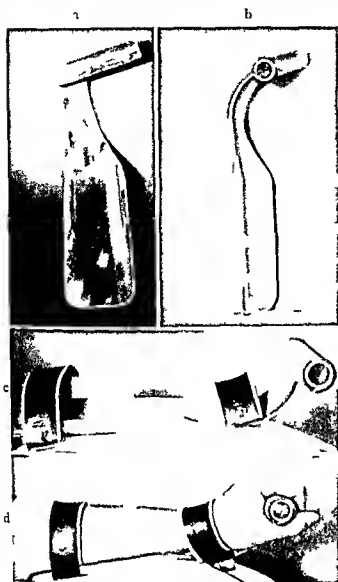


FIG. 1. Aluminum splint for maintaining the hand in the position of function.

at its upper end (Fig. 2 a) to which straps with buckles, steel springs and leather loops can be attached for the production of elastic tension on the thumb and fingers. Figure b shows the splint with straps for each finger. A sixth strap may be attached to the loop over the thumb to pull directly upward (in the line of the radius) and thus help to pull the thumb away from the hand into the abducted position, a consideration of particular importance if the thumb has been allowed to lie for days or weeks alongside the hand in the extended and prone position.

The elbow cuff (Fig. 2 a c) attached by straps and buckles to the upper corners of the splint helps to keep it from slipping down past the metacarpophalangeal joints when the pull on the fingers is increased.

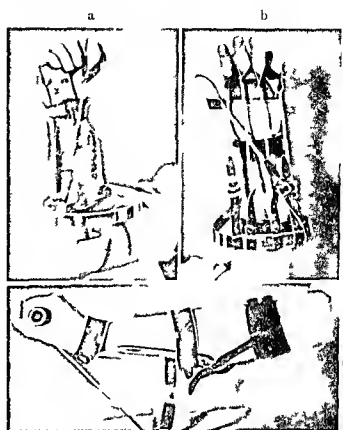
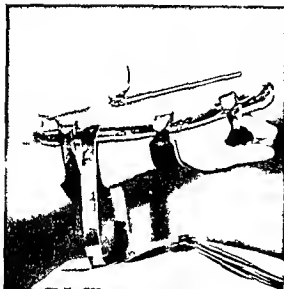


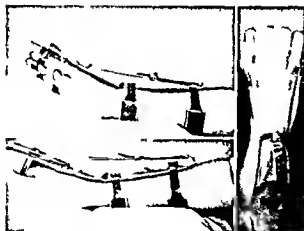
FIG. 2. The same splint as in Figure 1 with crisscross bar straps buckle springs and loops for the production of elastic tension in the finger and thumb so as to flex the finger and abduct the thumb from the hand. (In a and c only on strap buckle spring, and loop are shown so as not to make the illustration confusing from a multiplicity of straps.)

The third splint (Fig. 3) is designed to produce the same effect as the second but is applied to the dorsum of the forearm and hand in cases in which the presence of wounds or operative incisions makes it desirable to avoid any pressure on the volar surface or in cases in which involvement of the wrist joint makes it desirable to bring elastic tension to bear on the periarticular structures of the wrist. Dorsal flexion at the wrist is obtained with the aid of a hinge at the wrist and a backward pull on the hand secured with the aid of a strong spring on the back of the splint. The effect produced on the fingers and thumb is exactly the same as with the second splint. The elbow cuff to prevent the splint from slipping distalward shown in Figure 2 is attached in the same fashion to splint 3 but has been omitted in the illustration shown. Pressure on the styloid process of the ulna is eliminated by cutting out a rounded portion of the splint on the ulnar side just above the hinge.

The fourth splint (Fig. 4) like the third is



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hinged at the wrist and is applied to the dorsum of the forearm and hand. It is designed however to aid in the extension of contracted fingers and not as splints and 3 in the flexing of them. Slotted extension pieces for each finger and for the thumb if desired are riveted to the hand piece

and tension of any desired degree is applied to the flexed fingers with the aid of rubber or elastic loops and buckles. This splint is helpful in the treatment of tendon contracture and particularly in the treatment of that type known as von Volkmann's contracture. In the latter condition it is frequently impossible to extend the sharply flexed fingers until volar flexion at the wrist relaxes the contracted tendons. The hinge at the wrist in the splint illustrated permits volar flexion of any desired degree at the wrist. As the contracted tendons are gradually stretched one is able to straighten out the wrist and maintain tension of any desired degree by tightening the strap on the back of the splint and if necessary in increasing the strength of the springs or adding a second spring.

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SPONTANEOUS RUPTURE OF PYOSALPINX INTO THE URINARY BLADDER

S DI PALMA MD I ACS AND M M STARK MD FACS NEW YORK

WHILE we present in this article an instance of rupture of pyosalpinx into the urinary bladder it must be noted that pelvic affections involving the female internal genital organs or intestines whether of inflammatory or neoplastic origin will occasionally create a fistulous communication with a neighboring viscus which results in a spontaneous evacuation of accumulated pus. Rather infrequently such processes have involved the bladder alone and ruptured into its cavity. However cases have been reported in which occasional rupture has occurred into the urinary bladder as a result of appendicitis infected dermoids abscesses of the ovary extra uterine pregnancy pelvic tuberculosis tubal diseases of parasitic origin malignant diseases of the uterus adnexa and intestines and postabortal pelvic infection. The case of Fromstein and Serdjukoff in which an ovarian abscess ruptured into the bladder and the one of Sbrozzi in which in the course of an active pyosalpingeal process the adherent intestine opened into that viscus are conspicuous oddities illustrating bladder fistula.

Spontaneous rupture of tubal abscesses into the bladder occurs rather infrequently. Under the broad classification of pelvic abscess Perimond in 1897 collected 67 cases showing clinical evidences of spontaneous rupture into the bladder. In only one instance could it be definitely stated that the communication was limited to a tubal pus cavity. The other cases are described as being pelvic abscesses or abscesses of the broad ligament with varied spontaneous ruptures into the bladder vagina intestines and rectum or through the skin. A number of his cases followed parturition or abortion several were infected dermoids or other cysts of the ovary a few were infected ectopics. In the light of present day methods of diagnosis aided by cystoscopy all his cases appear to be poorly elucidated and cannot with the exception of one case be included in our series. Similarly Delbet has collected 958 cases of pelvic suppuration most of them without reported cystoscopic or operative findings. Of his cases of alleged rupture into the bladder none could be included in our series because convincing proof is lacking.

Spontaneous rupture is an unusual accident resulting from a distention of a pyosalpinx which is

often secondarily infected. Though a number of these cases are primarily due to the gonococcus many of them are of tuberculous origin. As usual under such conditions the pus tubes are enlarged and their close proximity to a hypersensitive and overdistended bladder results in involvement of these structures and a firm union occurs at some point as a result of a plastic exudate. Continuous pressure at the contiguous area causes the formation of a weak spot in the bladder wall and results in gradual and subsequent sloughing and rupture.

SYMPTOMS

The patients suffer from the usual symptoms of adnexal disease either of the acute or chronic type. Occasionally the initial attack is severe enough to involve the bladder and produce rupture following which there is a sudden abatement of all symptoms but often the original condition recurs subsequent to a temporary closure of the fistula the whole train of symptoms reappears and the patient slowly lapses into a condition of chronic invalidism. One case (Müller and Petitjean) was studied for 10 years before its true nature was discovered. Along with the symptoms of pelvic disease there usually are prodromal symptoms of bladder disturbances namely discomfort frequency tenesmus cloudy urine and occasionally hæmaturia. During this stage the pelvic pain and discomfort are aggravated the general condition is decidedly worse chills and rising temperature supervene and when rupture occurs there is often an attack of sharp pelvic pain and a sudden appearance in the urine of a large quantity of frank foul smelling pus. As already stated this marked pyuria is followed by a decided drop in the temperature and an abatement of all symptoms. Examination at this time reveals a diminution in the size of the offending mass. In a small number of cases there are no prodromal bladder symptoms and the sudden pyuria gives the first indication as to what is occurring. The maximum pus content is usually at the onset i.e. at the time of the first rupture. A thick greenish or yellowish foul smelling pus is characteristic.

The course after rupture is variable. The pyuria may last a few hours or a few days and then clear up entirely. This is a period of apparent cessation during which time the pelvic

condition remains quiescent. However the pathological process from another tubal excitation may cause renewal of symptoms and a re appearance of the pyuria consequent upon the re opening of the fistula. The patient's general condition thus becomes progressively worse most of the reported cases were in distressingly poor condition when they presented themselves for final care. The instance of a 10-year duration has already been alluded to. This chronicity and invalidism are observed principally in the tuberculous cases. Frequently in fistulae due to a pyosalpinx of gonococcal origin a spontaneous cure of the fistula occurs.

DIAGNOSIS

A clinical condition so characteristically manifested as just outlined is not likely to escape one's notice. A reasonable amount of alertness will often establish it from the train of symptoms. Yet the absolute aid afforded by the cystoscope makes it possible to make the diagnosis by this means alone. The finding of an opening in the bladder and skiagraphy of a contrast medium after filling a neighboring cavity through a ureteral catheter is all that is necessary to determine the existing pathological condition.

CYSTOSCOPY

The finding of an opening in the bladder wall and cystography of the neighboring cavity after it has been filled with a contrast medium such as an iodide solution iodopin or lipodol will firmly establish a diagnosis already presumptive on clinical evidence. Sometimes only an isolated area of redness in an otherwise normal bladder is seen at the site of expected rupture while on subsequent examination a characteristic puckering and possibly a crater like opening may be present. A normal looking bladder wall except for the tell tale isolated area just described is often found. Characteristic indeed is the presence in this reddened oedematous puckered area of a small opening through which pus is seen exuding and into which a small catheter can be passed but investigation does not always reveal this condition.

The use of three catheters one into either ureter and the third into the pus cavity further clarifies the situation. This method was used in the case recorded by Beer.

In the collected cases it is often reported that cystoscopy performed some time after rupture with clear urine showed no opening but only the tell tale reddened and puckered area in sharp contrast to an otherwise normal mucosa. As this

condition was evident in the case presented we resorted to another method of proof not previously attempted but yet confirmatory.

A long large bore aspirating needle was plunged into the offending adneval mass through the vault of the vagina and a quantity of thick foul smelling pus was withdrawn (the pus had the same physical and cultural characteristics as that previously noted in the urine). With the needle remaining *in situ* a quantity of a 20 per cent solution of sodium iodide was injected into the cavity the needle was then withdrawn and the vagina tamponaded. The bladder was catheterized and a skiagram immediately taken (Figs 1 and 2). The pus cavity was clearly outlined and in addition a small quantity of the opaque substance was found in the bladder. The bladder accumulation was then drawn off and was found to contain iodine. Subsequent hourly examinations were continued throughout the day and each of these revealed the presence of iodine. The usual site of rupture occurs on either side of the utereral openings on the lateral or posterior wall.

TREATMENT

The case of Duvergey and Dax considered by them as being the first case (1922) in which skiagraphy was used as an aid in the diagnosis of this condition was treated by transvesical intratubal instillation of 1 per cent silver nitrate. Their comment is that the bladder symptoms cleared up and the adnexa became reduced in size. Other cases have responded to bladder lavage rest in bed and supportive measures while others have done well after simple colpotomy. It is reasonable to suppose that frequent evacuation of the pus cavity combined with rest and various other measures will greatly help to restore a patient to a fair degree of health. Most of the patients are in such poor general condition when first seen that one is never anxious to assume an operative risk until after the general health has been improved.

A good method of treating these cases follows. When rupture takes place bladder lavage and urotropin or hexylresorcinol should be given until the urine clears and vesical symptoms subside. Transvesical lavage of the pus cavity is valuable as it favors drainage. If pelvic abscess intervenes colpotomy can be done. If the inflammatory process thus comes under control the best time to operate is after a short period of levelled temperature and a repeated white cell count of 10,000 or less. The operation by laparotomy should aim to remove all pathological tissue. The site of rupture into the bladder



FIG. 1. Pyosalpinx abscess. A large trocar needle has been inserted into the cul-de-sac.



FIG. 2. The pyosalpinx abscess is filled with a solution of potassium iodide. The abscess cavity is well outlined and is immediately on between the abscess cavity and the bladder. Some of the iodide solution is seen in the bladder.

should be sought out and the damage repaired either by simple suture or by resection of the ulcerated area. In our opinion these operations are not complete unless drainage through the vault of the vagina is effected in the cases due to a non-tuberculous pyosalpinx.

PROGNOSIS

Of the 34 patients reported 9 were not operated upon of these 1 died 2 reported that their health was improved and 6 reported cured or end result not known. Of the 25 patients who were operated upon 14 were cured 1 responded to transvesical instillations (Cotillon) were not reported and 8 died. The ages ranged from 22 to 48 years. The presence of tubercle bacilli was recorded 6 times of tubercle and colon bacilli once and of streptococci and colon bacilli once. In 1 case no growth resulted while in 3 cases the type of organism found was not reported.

CASE REPORT

W. D., a widow 35 years of age was admitted to the Harlem Hospital on March 24, 1927 with a proved gonorrheal urethritis and endocervicitis of 3 weeks duration. During that time she had had severe pains in the lower abdomen, chills, fever and frequent and painful micturition. Pelvic examination revealed the presence of bilateral tender masses. The left mass was larger than the right and bulged anteriorly into the vault of the vagina and likewise into the cul-de-sac. The first urinalysis showed many pus cells. The temperature ranged from 101 to 103 degrees but slowly subsided. Cystoscopy on March 28 revealed a congested mucosa and on the left wall of the bladder beyond the ureteral openings a much darker area but no puckering.

One week after admission following a sudden severe pain in the lower abdomen the urine became thickened with a greenish yellow foul smelling pus. There was prompt relief of the pelvic pain and an improvement in the general condition. The left lateral mass was also reduced in size. Thus far the clinical manifestations indicated that the left lateral mass had ruptured into the bladder. When the urine began to clear about 5 days after the rupture a more extensive examination was undertaken.

A catheterized specimen yielded the same thick pus just described and on cytology at the site on the left lateral wall of the bladder was an area of edema infiltration and plication of the mucosa covered with mucus and plaques of epithelial debris. The rest of the mucosa was only slightly congested. No direct opening was found and no new pus contaminated the field during the examination. Smears and cultures of the pus showed cocci in toto and in short chains.

At this time an aspirating needle was plunged through the vagina into the left lateral mass (Fig. 1). A quantity of pus was withdrawn and was found to be similar in all respects to that found in the bladder. Through the needle left in situ a quantity of 20 per cent sodium iodide solution was injected and a roentgenogram taken. The opaque fluid was seen in the pus tube region (Fig. 2) and some of it was also seen in the bladder. A catheterized specimen at this time another specimen obtained during the day revealed the presence of the iodide. After subsidence of all symptoms and with levelled temperature and satisfactory blood count (under 10,000 white blood cells) an operation was performed by one of us (D.P.) on April 15. Bilateral adnexal suppuration was encountered and properly dealt with and in the presence of a febrile mural fibroid hysterectomy was performed. The tubercle of the bladder communication was found and lambertized and drainage established through the cul-de-sac through firm gauze. The convalescence was uneventful and the patient left the hospital on May 2, 1927.

CONCLUSIONS

1 Spontaneous rupture of a pyosalpinx into the urinary bladder is very rare

The symptoms are clinically characteristic. Following sharp pelvic or suprapubic pains large quantities of frank, oftentimes foul smelling pus appear in the urine and there is a drop in temperature & relief of urinary and vesical symptoms and a decided improvement in the general condition of the patient. Cystography and cystoscopy add convincing data to an otherwise obvious clinical diagnosis.

A patent ostium is not always visible in the bladder wall but an isolated area of edema or redness with a crater like central depression together with pelvic pathology is presumptive evidence of impending ulceration or rupture. The site of the rupture is usually on the lateral wall just beyond and to one side of the ureteral opening. An absolute diagnosis is reached by means of roentgenograms taken after the pus cavity has been filled with opaque fluid either transvesically or by the authors' method.

4 A rupture may heal spontaneously as may also the original abscess and later recur several times especially if the patient is in poor general condition as a result of chronic invalidism.

5 Operation by laparotomy to remove all disease is the proper method of treatment and is best undertaken when the temperature is levelled and the white cell count less than 10,000.

6 The fistulous communication between the pus-sa and the bladder cannot always be found at the time of operation but when it is found it is given the necessary surgical attention. Drainage by intubating catheters and by gauze through the vaginal vault is recommended.

CASES REPORTED IN THE LITERATURE

The following 34 cases including the authors were gathered from the literature. As previously stated many reports could not be included in this study because of the lack of sufficient evidence.

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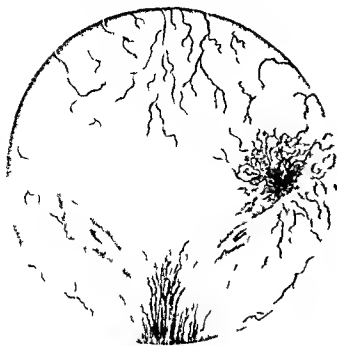


Fig. 3 Cystoscopic appearance just before the rupture occurred

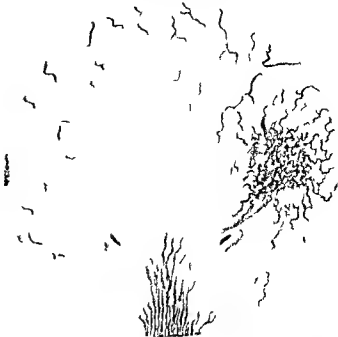


Fig. 4 Cystoscopic appearance several days after rupture has taken place. Note the absence of any aperture

Cystoscopy revealed a normal bladder wall but the right ureteral opening showed swelling. Beside it was seen a small opening through which pus escaped. Panhysterectomy was done. No communication with the bladder was found although the right pus tube was found to be adherent to the bladder. Vaginal as well as abdominal drainage was instituted but patient died.

15 Case of Muller and Petitjean. For 10 years a patient 38 years of age had had symptoms indicating perforation into the bladder of a purulent process. Bacteriologic examination of the purulent urine and cystoscopy were negative. Hysterectomy and removal of adnexa were done and no communication with the bladder was found. No drainage was instituted. At autopsy the site of the perforation was discovered.

16 Case of M. Bulcke. The patient 2 years old had had purulent urine for 2 months. Cystoscopy revealed a fistula in the posterior wall and at operation it was found to communicate with a large left pyosalpinx. An indwelling catheter was inserted. Recovery.

17 Case of A. Funke. The patient had had pus in the urine for 3 months after parturition. A perforation was found on the left posterior wall. Laparotomy was performed. A remnant of the pus sac left adherent to the bladder wall obscured the perforation. Cure after 4 days.

18 Case of A. Funke. The patient 33 years of age reported that rupture into the rectum had occurred prior to rupture into the bladder. At operation a communication between the bladder and the right pus tube was found. Recovery occurred within a year.

19 Case of A. Funke. At laparotomy two perforations into the bladder were found and sutured. Recovery. Only one other case has been reported in which more than one fistula was found.

20 Case of A. Freund. Chronic uppuration into the pelvis had been noted for a few years following several operations for fistulous openings into the bladder and intestines and through the abdomen. The patient was in poor condition. At laparotomy the abscessed adnexa were removed and the two perforations into the bladder were sutured. Death.

21 Gavet (1922). The patient 4 years old had had pyuria and lumbar pains for a year and was very feeble as a result of the illness. A mass was noted on the right side. Cystoscopy revealed severe edema of the upper and posterior wall of the bladder and exudation of pus or serous albits in this zone. The rest of the bladder wall was normal. Operation was followed by cure. Guinea pig inoculation showed tuberculois.

22 Gayet (1922). The patient 23 years of age had had considerable pus in the urine. Cystoscopy showed false membranes in the bladder. The catheterized kidney urine was clear and negative on inoculation. A second cystoscopy showed a bulbous area above the left ureter and in the center of this there was a slit filled with a plug of pus. Pressure on the adnexa caused a discharge of pus through the opening. Operation revealed a left pyosalpinx tuberculous in character. No penetration into the bladder was found. Cure.

Gayet reports 3 additional cases of tuberculous pyosalpinx opening into the bladder but the opening was not clearly demonstrated.

23 Au ray's first case. The patient 38 years of age was in poor general condition. She was admitted to the hospital in March 1912 and a diagnosis of right salpingitis was made. The urine contained pus but no cystitis was present. Cystoscopy showed the right side of the bladder to be reddened but no opening was seen. The condition improved after lavage. Cystoscopy one month later showed a characteristic opening, and exuding pus. At operation performed on July 2, 1912, a fistula was found and sutured. Cure.

24 Au ray's second case. The patient was admitted to the hospital in December 4, 1912. Pus had been noted in the urine for months. Cystoscopy showed the entire wall to be red and vascular. The left ureteral opening was gaping and surrounded by a red congested area. Just outside of this was seen a small area of edema with a central depression from which pus exuded. At operation the penetrating into the bladder was found and sutured. Death.

5 Au ray's third case. The patient was admitted in June 1913 after 2 months of illness due to pelvic disease.

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4 CO ON P Th e d d t l g 9
5 DAVIDSON A H I h j M Sc 97 v 9
6 D L T t d p p a t n p l h l a
f e m m P n 89
7 DEVERG Y D D A X J d o l m e d t h u 97
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8 FAUVE GHE M Th d d e t l i l l 9
9 FREUND W l b t G b t h Gyn k 1908
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11 FURNE A Beitr Geb t h Gyna k 899
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12 GAYET Ly ch 93 x 67 69
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35

THE COINCIDENCE OF HYPERPLASIA ENDOMETRII AND CARCINOMA CORPORA UTERI

C F FLUHMAN, M.D. AND H A STEPHENSON, M.D. SAN FRANCISCO, CALIFORNIA
1 mth D p tm t f ob t t 1 Gy col y s f d u b S h l f m d u

HYPERPLASIA of the endometrium is the most important single factor concerned with abnormal uterine bleeding at the time of the menopause. In this respect it must constantly be considered in the differential diagnosis from carcinoma of the body of the uterus and it is thus of prime importance to determine its exact relation to malignancy and how frequently the two conditions may coexist.

There have been but few cases reported in which carcinomatous areas were found in hyperplastic endometrium. In 1906 Doca (3) described a specimen obtained from a patient 45 years of age. The uterus was involved in a diffuse myoma the mucosa was markedly thickened and presented the usual appearance of hyperplasia of the endometrium while in one area could be seen a definite early glandular carcinoma.

R Schroeder (13) found definite malignant changes in the hyperplastic endometrium of 2 patients. Since these women had passed the menopause several years before he was uncertain as to whether the condition should be regarded as a simple hyperplasia endometrii or as more in the nature of a diffuse adenoma with a tendency to malignant degeneration. In a more recent work (14) however he mentions the possible occurrence of carcinoma in hyperplastic endometrium and presents an illustration of this phenomenon. Ewing (4) states that he has seen 3 cases of carcinoma arising in the hypertrophied glands overlying the most prominent points of submucous myomata. Finally R Meyer (10) has reported 5 very interesting cases of hyperplasia endometrii associated with malignancy and he was able to point out a very important fact namely that an adenomatous cancer not only may have its origin in hyperplastic mucosa but may arise directly from previously simple hyperplastic glands.

The use of repeated curettages in patients with hyperplasia of the endometrium has shown that this lesion is occasionally succeeded by a carcinomatous condition. Baecker (1) has described the case of a woman who was curetted 20 times over a period of 10 years. The first seventeen curettages showed an endometritis glandularis the next two an adenoma benignum and finally an adenoma malignum. A somewhat similar experience was reported by Horsley (8) who found a hypertrophic

endometritis on two occasions while the third operation revealed a low grade adenocarcinoma.

In this connection reference must also be made to a rare condition which was recently reviewed by one of us (Fluhmann 6). In this lesion unusual masses of epithelial cells resembling the basal layer cells of squamous epithelium occurred in close association with the glands of hyperplastic endometrium. The exact significance of this change has not been determined with certainty and although there is every reason to believe that it represents a benign process in the nature of a metaplasia of cylindrical to squamous epithelium a number of authors who first described it considered it as unquestionably carcinoma.

Although the term precancerous lesion has been applied to endometritis glandularis by a few authors (McCann 9 Findley 5) the evidence advanced is not conclusive and the consensus of opinion seems to be that the association of hyperplastic endometrium with malignancy is very unusual. It was apparently not noted in the cases of cancer of the corpus uteri studied by Schottlaender and Kermauner (12) and the only case described by Cullen (2) in his book was not a generalized hyperplasia but was localized in polyp of the fundus. Frankl (7) simply states that in cancer of the body he did not find hyperplastic changes more frequently than usual. Novak and Martzloff (11) in their extensive study of hyperplasia endometrii state. In regard to cancer of the corpus or fundus uteri we have observed in our laboratory only 1 case of cancer associated with endometrial hyperplasia an almost negligible incidence. In this case furthermore the carcinoma which was of ovarian origin pushed into the endometrium from the outside. The endometrium played a purely passive role so that this case has no significance as indicating a predisposition to cancer in cases of hyperplasia. We are convinced that no such predisposition exists.

A review of 22 adenomatous carcinomata of the body of the uterus seen at the Stanford University Hospital during the past 10 years reveals no case associated with hyperplasia of the endometrium. The following case however which was recently attended by one of us (S) shows a coincidence of the two conditions in a very remarkable manner.

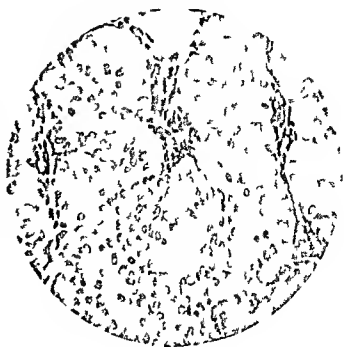


Fig. 4. Photomicrograph showing the close association of a solid nest of cancer cells several carcinoma glands, a normal endometrial gland and a cystic hyperplastic gland ($\times 500$).

tion (Figs 3-4). There are a few normal endometrial glands with high cylindrical epithelium such as are usually noted during the interfoliophase. Several cystic glands lined with a low cuboidal type of cell and with the lumen clearly outlined are present in considerable numbers. There are also a few convoluted glands which are generally lined with a single layer of cells but are stratified in some places and in others send out little tufts or papillary projections into the lumen. The basement membrane of these glands is intact and their occurrence has been noted frequently in hyperplasia endometrii. The next type of gland seen apparently represents an early carcinomatous change in that there are occasional mitotic figures and stratification into from two to four layers but the basement membrane is still intact. Finally one finds definite carcinomatous glands with tremendous proliferation of the cellular elements extension into the stroma and the formation of dense masses of cancerous tissue in which the outlines of the individual cells cannot be made out (Fig. 5).

Although all of the tissue obtained from the cuttings was mounted and numerous sections were made the case just described is the only one showing, undoubtedly, malignant changes. The only possible exception is a single gland found in a markedly hyperplastic area which presents striking similarities and such stratification of the cells that it must be considered as at least suspicious if not definitely carcinomatous.

Gospocn. The ute us is unformly enla ed
weiht 180 grams and measu es 05 by 55 by 80 centi
meters. It is a ft consisteny and does not present any
other gr al normalty e ept a few small cystic ut
tur s in the myometrium immediately subjacent to the
endometrium. These vary from the size f a pinhd t 4
millim in s in diameter and contain clear mucoid material.
The endometrium measures from 2 to 4 millimeters in
thi es is r egular and shap f a purplish color and
at the left cornu there is a small polyp 8 by 3 millimeters.
The cervix is hypertrophied and contains a few small

the end of the year, the area of land under the

cysts Thel l f i n t l i mal Th l ft arv ap
pea n r al f t f v mall yst c nta n l ar
yell v h l l d l l r i h t a t r a n s a l l d t i l d
c y t a b y l y i t e s a i t m d i a l p l e

the uterine tube. On microscopic examination the tubal incidence of the malignancy is not demonstrable at any point.

Placenta and the metrum consistent with the
 out the hileute ov. On the p. e. o. c. t. a. the
 superhcrst taa abs ntr n. nes e me ely a th n b sal
 layer c ntam few n mal and many d late l n c t i c
 glands (fig 6) The s r f i c. r e p r e s e n t e d b y a thin lay
 of fb. I l o d lot and inflammatory cells. The p l y p
 n ted gro ly show hyperpl stic end metrum a d may be
 an artef t resulat f m th curetta e. A few lymph
 f hicle ar not d i n th end metrium and there is
 slight und cell infiltrat n in me eas but this n t r

significant features. The myometrium shows some hyperplasia but there are no myomatous formations. There are extensive deposits of endometrial gland some of which are accompanied by stromal invasion into the myometrium (Fig. 1). They are situated within the outer third of the uterine cavity and since the leiomyosarcoma is a circumscribed tumor the condition is regarded as an adenocarcinoma (Frankl) rather than an adenomyoma. Another striking finding is the presence of numerous large blood vessels some of which show hyaline changes both in the basal endothelium and in the myometrium immediately subjacent. There is extensive chronic inflammation, changes with several cystic glands. The fallopian tubes show no abnormality. Both ovaries were studied in detail. A corpus luteum of recent origin could not be demonstrated in either ovary. Histologically, the extent and number of small foci of carcinoma in the uterine muscle are more extensive than in the myometrium. The large blood-filled cysts tend greatly to the right ovary. It would be hard to find a cell many of which have found a new transformation into lymphocytes.

Histopathologic studies (r) Hyperplasia of the endometrium () Adenomatous carcinoma of the corpus uteri



(3) Ad my t t (4) Ch m c r c t (5) Fil l
l fll g u t t g (X ∞)



F 7 E t e s t f e n d m t l t i n t t h e n
m t m (X ∞)

(3) Ad my t t (4) Ch m c r c t (5) Fil l
l fll g u t t g (X ∞)

We have thus demonstrated in this case a condition of marked hyperplasia of the endometrium accompanied by an adenomyosis uteri. In this endometrium was found an early adenomatous carcinoma which apparently was arising from previously simple hyperplastic gland. The only detailed description of such a process that we have been able to find is the case mentioned by R. Meyer. Another interesting feature presented by this patient is that apparently all the cancerous tissue was removed by the curette, a possibility which has already been reported by a number of observers.

Although this case is of considerable scientific interest we feel that it can add little to our conception of hyperplasia of the endometrium. The condition is extremely common and its occurrence with malignancy of the body of the uterus is comparatively rare. As Novak and Martzloff assert hyperplasia of the endometrium cannot be regarded as predisposing to a cancerous growth. However the possibility of coincidence no matter how slight does exist and one must always bear in mind the importance of careful study of all tissue obtained from the uteri of women with abnormal bleeding at the time of the menopause.

SUMMARY

A study of the literature shows that only a few cases of hyperplasia of the endometrium asso-

ciated with malignancy of the body of the uterus have been reported. This coincidence is thus regarded as very unusual. A case is described in which abnormal bleeding occurred in a patient at the menopause. The histopathological examination of the uterus showed an early adenomatous cancer arising in the superficial layers of a hyperplastic endometrium. All the malignant tissue was apparently removed by the curette. The hyperplasia was accompanied by an adenomyosis uteri.

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t m r o a p h s d t e h l k c n d t h t s t l y

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4 Idem A t St eck l H db h d G y k l
3 d d M ch J F B gm n 9 3 3
3 7

FATAL EMBOLUS DUE TO INFLATION OF BLADDER WITH AIR¹

CHARLES PIERRE MATHÉ M.D. F.A.C.S. SAN FRANCISCO, CALIFORNIA
Fifth Department of Urology, St. Mary's Hospital

AIR embolus has long been recognized as the cause of alarming symptoms or death following the inflation of the bladder or urethra with air for diagnostic and operative procedures, yet its danger has not been sufficiently emphasized. It is still the common practice of many urologists of repute in the leading hospitals in the United States and abroad to employ air in inflating the urethra and bladder. Having recently experienced a fatal embolus following inflation of the bladder with air, I have attempted to ascertain its incidence by sending questionnaires to the members of the American French and Roumanian Urological Associations, to the well known genito urinary surgeons of Europe and to members of the American College of Surgeons doing urological surgery. The results from this inquiry and from a perusal of the literature shows that its occurrence is rather common. For the purpose of preventing its occurrence in the future I present my case in detail.

Hospital No. 48454, male, age 56 years, president of a foundry, referred by Dr. E. Boldemann, entered St. Mary's Hospital October 3, 1917, complaining of hæmaturia, inability to urinate, frequent urination, dysuria and nycturia.

Patient's mother died of cardiovascular and renal disease, father of apoplexy, and one sister of scarlet fever. One brother is living but suffers from numerous varicosities.

Patient has had gonorrhea but denies having had syphilis. He was circumcised when he was 25 years old and had neuritis when 51.

In January 1917 the patient developed increased frequency of urination with nycturia. There was a sensation of fullness in the perineum and at times the patient noted that the urine was turbid and had a foul odor. At this time the size, force and projection of the urinary stream became diminished and he experienced the sensation of not completely emptying the bladder. This condition became progressively worse and required considerable straining to force out a few cubic centimeters of urine until on October 1, 1917, complete retention took place. Two weeks later he developed a severe attack of hæmaturia, passing bright red blood and a number of clots which cleared up in 3 days without any treatment. Three days later he developed a second attack of hæmaturia which convinced him that he should seek medical aid. No particular pain was experienced in the lumbar or sacral regions. In the past month he had lost 5 pounds in weight.

Physical examination. The patient was of the short stocky type and he had a thick neck. Auscultation of the heart revealed slight roughening of the first sound in the region of the tricuspid valve. The pulse was normal. In the region of Grocco's triangle the lungs presented an inspiratory wheeze terminated by small coarse râles. The blood pressure was systolic 166, diastolic 80. Examination

of the blood revealed hemoglobin 90 per cent, erythrocytes 5,030,000, leucocytes 16,900, polymorphonuclear leucocytes 85 per cent, small mononuclear lymphocytes per cent, large mononuclear lymphocytes 4 per cent, coagulation time 4 minutes, Wassermann reaction was negative.

In examining the blood 49 milligrams of urea per 100 cubic centimeters were found, 33 milligrams of non-protein nitrogen per 100 cubic centimeters, and 1.8 milligrams of creatinin per 100 cubic centimeters. The intramuscular phenolsulphonaphthalein test yielded 70 per cent in 4 hours.

Urological examination. Tenderness and dullness were elicited in the suprapubic region and although neither kidney was palpable considerable tenderness was found in the costo vertebral angle on both sides. Rectal examination showed the prostate to be enlarged about five times its normal size, symmetrical, soft and bound down laterally by adhesions. Cystoscopic examination revealed a bladder containing 50 cubic centimeters residual urine with a capacity of 300 cubic centimeters, intravesical encroachment of the middle and lateral lobes of the prostate, an ulcerated area on the left anterior octant of the bladder neck, and a round papillomatous mass about 4 centimeters in diameter in the base of the bladder. Plain roentgenograms were negative except for a small shadow in the left side of the pelvis presenting the appearance of a phlebolith. On account of obstruction of the outflow of urine caused by the enlarged prostate it was decided to remove the gland by the suprapubic route and if feasible resect the papillomatous mass at the same time. The usual suprapubic incision was made and the bladder inflated with 300 cubic centimeters of air with a syringe. A hissing sound (*sifflement*) was heard in the bladder during a period of a few seconds and as the silk guy sutures were inserted into the fundus of the bladder the patient became cyanotic, the eyes fixed, the pupils dilated and the pulse and respiration suddenly ceased. Immediately after the heart beat could not be elicited. Caffeine and camphorated oil were injected hypodermically, adrenalin directly into the heart, artificial respiration resorted to and oxygen introduced into the lungs. At the end of 30 minutes it was found that these efforts had been of no avail.

Necropsy. The patient was a well developed and nourished man. The pupils were equally dilated and the mucous membrane pale. The teeth were well preserved and presented numerous gold fillings. When the abdominal cavity was opened small bubbles of air were found in it, as the mesenteric vessels, the vena cava and in the renal veins. The lungs, liver and the right chambers of the heart contained a coarse froth of air. The coronary arteries presented advanced atheromatous changes. The bladder showed considerable thickening of its wall, an intravesical encroachment of the prostate, ulceration of the neck, and a tumor mass in its base measuring 4 centimeters in diameter which had invaded the muscular coat and had presented necrosis in its center. Both kidneys presented a moderate degree of hydronephrosis.

The tumor mass located in the base of the bladder was removed. It was of a hard consistency and had invaded all three coats of the bladder wall. An irregular ragged greyish white ulcer was found in its center under which there was a hard base. Microscopic sections of this tumor showed that the continuity of the epithelium was broken by necrosis

l l h d t k p l t l t f t h t m The
fa p t h l m hlt d d by t l t m wh h
t d f t v l g l d l l p t m y
m t t i d b t m t I t h l t t
m b f c up f t p l p t l l l e e Th
h l d l l h d f m d me d f i t A
m b f t h b l d e l w r f d t o h b f
t d b t h t m c l l D g ad m f
the H l d d

OCCURRENCE

Alarming symptoms and death due to the introduction of varying amounts of air into the circulatory system were early recognized by Morgagni Claude Bernard Bichat and many of the earlier investigators. On the battle fields of the Napoleonic wars soldiers were often observed to die from air embolism resulting from saber wounds of the neck. In 1818 Beauchêne reported the first authentic case proved by autopsy in which air had been aspirated in the course of an operation on a tumor of the neck. In 1883 Treves collected as many as 67 such cases adding two of his own in which air embolism was quickly recognized and successfully treated. Manauray reported a case occurring during an operation for fracture of the clavicle and Depage and Courvoisier reported others accompanying the removal of new growths of the neck in all of which the characteristic *sifflement* was heard. Davidson reported embolus following distention of the uterus with air and Crile in discussing Bensen's classical lecture on the subject reported fatal embolism following the injection of air under pressure into an abscessed cavity of the pelvis the negative pressure in the aspirating chamber having been accidentally substituted for positive pressure. Wolf is of the opinion that spontaneous emboli may result from a collection of gas beneath atmospheric pressure in an ulcerated stomach or diseased uterus. Revenstorf saw a fatal case result from suicidal cutting of the throat. Saugman von Adelung and Schlapfer reported that it is not uncommon to find air embolism accompanying various diagnostic and therapeutic procedures of the chest. W. M. Spitzer encountered a fatal case which was due to the injection of the perinephric tissues with oxygen for diagnostic purposes. In 1903 Sick reported fatal embolism proved by autopsy following an attempt to dilate the bladder with a syringe in the course of operating on a carcinoma of the bladder. In 1913 Nicolich added another and Marion two cases also proved by autopsy in which embolus occurred following dilatation of the bladder with air in the course of performing a prostatectomy. Fox Mark Joly and Ward reported cases of emboli after air inflation of the urethra in performing urethroscopy.

We sent 550 questionnaires to the various surgeons of this country and abroad doing genito-urinary surgery of which 797 were answered. A general preference was expressed for the use of water in inflating the bladder and urethra. A number of surgeons prefer water for distention of the bladder and urethra and use air only in making contrast cystograms. A number employed air alone whereas a few surgeons used either oxygen or no inflation. The main objection to air seemed to be the likelihood of experiencing embolism from its use. Those who continued to use air preferred it for the reason that it is cleaner than water because it does not run over and infect the operative field and perivesical tissue. A small number expressed their preference for oxygen but its use seems to be as dangerous as air. A smaller number of emboli were reported following the distention of the bladder with aqueous solutions. All urologists who had noted untoward symptoms resulting from the employment of air were very emphatic in condemning its use.

ETIOLOGY

The presence of air under pressure in the normal bladder and urethra causes no harm as evidenced by the enormous number of cases in which it is being daily injected without the least signs of ill effects. The formation of emboli takes place by the entrance of air into the venous circulation either through an ulceration of the mucosa caused by some preexisting pathological lesion such as an ulcer a tumor a deeply congested area due to cystitis etc. or through a laceration of the mucosa caused by overdistention of the bladder. The veins that are particularly susceptible to the entrance of air are those whose walls are thickened or bound up in inflammatory material or those of a new growth. If air is injected into a healthy bladder through a catheter it will regurgitate back between the catheter and the urethral wall long before the mucosa becomes ruptured. On the other hand if prostatic enlargement or stricture formation has caused tight approximation of the catheter to the urethra increase in pressure can cause rupture of the bladder wall the mucosa being the first to be lacerated. Once the veins of the bladder wall are ruptured a minimum amount of pressure can cause penetration of air into the venous veins and thence into the venous cava and right heart.

In discussing his case of fatal air embolus resulting from inflation of the bladder with air Nicolich referred to the theory of Lewis who thought that air entered into the circulation by way of the pelvis after having regurgitated up

through the ureters. Following this report Santini injected air under considerable pressure into the bladder of dogs and found that the healthy bladder invariably ruptured before air would enter the pelvis by way of the ureter. Air was then injected directly into the abdominal portion of the ureter and he reported that in this way it was possible to introduce air directly into the general circulation by way of the renal parenchyma. Shortly after however Poddighe was unable to confirm these observations. He injected air into the lumen of the ureter of 11 dogs under considerable pressure over a period of 15 minutes 30 minutes and longer and found that although he was able to produce considerable augmentation in the volume of the kidney he was never able to produce death by air embolus. Careful autopsy of these dogs revealed huge dilatation of the pelvis and the tubular system of the renal parenchyma with enormous compression of the glomeruli. The dilatation of the pelvis and tubules were responsible for the markedly increased size of the kidneys but in no cases had the air entered the cardiovascular circulation. In dogs in which the veins of the bladder walls were traumatized inflation of the bladder under minimum pressure caused death in a few moments and autopsy revealed air emboli and frothy blood in the right heart.

Graves and Davidoff have shown experimentally that fluids may regurgitate from the bladder into the kidney by way of the ureters. The earlier investigations of Poirier and of Lewis and Goldschmidt and the more recent work of Hinman and Lee Brown on pyelovenous back flow indicate that solutions are readily absorbed by the veins of the pelvis. In reporting recent research on the physiology of the ureter F. Fuchs demonstrated that air can enter into the venous circulation of the calyces. This entrance of air is more likely if there is an ulceration of the mucosa of the pelvis due to some pre-existing pathological lesion or to laceration due to overdistention. Such was not true in my case.

PATHOLOGY

Since the classical case of Beruchesse in 1818 the danger of air embolus has been emphasized in the teaching of surgery. Even before that time Bichat and others believed that the entrance of a very small amount even the smallest bubble of air would be followed by very serious consequences. In 1885 Senn and in 1889 Hare reported extensive experimental studies showing that fairly large amounts of air could in some cases enter the veins without disastrous results. This was followed by the work of Goodridge Larned and others who concluded that when an appreciable



Fig. 1. Calicoma of the bladder presenting ulceration of the os, through which air entered the venous system, causing fatal embolus. Actual size.

quantity of air entered the veins the result might be rapidly fatal and by those of Blair and McGuigan who clearly demonstrated that this is particularly true when the air enters under pressure.

When air enters the right ventricle in even as small amount as 4 cubic centimeters the arterial tension is lowered the venous tension raised and the contraction of the heart and the action of the lungs are considerably disturbed and are for a time rendered less efficient. These cardiorespiratory changes are uninfluenced by bilateral vagotomy (Quilliot). If a larger amount enters this disturbance becomes increased giving rise to grave symptoms or death. Three theories have been advanced as to the cause of death—cerebral pulmonary and cardiac disturbances. Morgagni and Bichat advanced the first theory—embolus formation in the brain itself. Death in such cases was attributed to syncope resulting from anemia of the vital centers of the bulb. Claude Bernard Vulpius Quilliot Wolf and others favored the second theory. They believed that air in passing from the right heart into the lungs formed ventral emboli which closed the various branches of the pulmonary artery resulting in death by suffocation. Magendie Amussat Depage Goodridge and others in supporting the cardiac theory attributed the grave symptoms arising from the introduction of air into the circulation to the lack of stimulus producing blood in the right heart or to a direct deleterious reflex action of air in the heart itself. They explained that large amounts of air in the right heart reduced the intracardiac pressure to such an extent that it could not overcome the resistance of the pulmonary capillaries and that as the heart beat was of no avail stagnation of the entire circulation soon resulted thus

TABLE I—METHODS USED BY SURGEONS

| | Numb
of |
|--------------------------|------------|
| Air d i t t (590 ft ton) | 34 |
| W t d tent (46 6 ft t) | 464 |
| A d w t d t t | 7 |
| O g d t t o | 6 |

TABLE II—METHODS USED BY UROLOGISTS

| | Numb
of |
|-----------|------------|
| A d t t | 47 |
| W t d t t | 588 |
| O b d t t | 6 |
| N f t t | 8 |

TABLE III—EMBOLI AFTER INFLATION
WITH AIR OR WATER

| | C |
|-------------------------------------|----|
| Air f t f b l d d e e t h a w t h r | 34 |
| Air f t f b l d d u t h t h w t | 14 |

causing death by lack of nutrition of the vital centers. Laborde and Frey concluded that death is brought about by a triple mechanism in which all three of the above theories play a rôle.

All investigators agree that small quantities of air can be introduced into the venous system at intervals causing slight or only transitory symptoms due probably to the ability of the blood to absorb air whereas if the total of these amounts were suddenly introduced under pressure grave symptoms or death might ensue. Marked difference in resistance to air embolism exist in different individuals and in different species. Hare observed that the introduction of 3 cubic centimeters of air into the venous system of three human beings caused no symptoms whatever whereas Blair and McGuigan noted that the injection of 4 cubic centimeters of air into the circulation of dogs was followed by marked cardiac and respiratory changes. Delbet and Mocquart demonstrated that the coefficient of danger in dogs consists of the injection of 6 to 7 cubic centimeters of air per kilogram of body weight per minute. Rabbits and monkeys are particularly susceptible while goats and some species of dogs are extraordinarily immune.

When air enters the right ventricle it prevents the proper closing of the auriculoventricular valve on that side and the light elastic air present in the vena cava readily allows regurgitation from the auricle. Each contraction of the heart causes the air to be churned backward and forward in the vena cava in the form of a coarse froth. The lack of the normal stimulus of blood in its cavities causes weakening of the contraction of the heart itself which is less efficient during this time. As a result of these two factors little or no blood

reaches the left ventricle and the whole circulation including the coronaries and arteries supplying the vital centers in the bulb suffer from lack of nutrition resulting in respiratory failure cardiac anæmia and deterioration of the heart muscle. In every case the respiration was found to cease first the heart continuing to beat for some time after. If the circulation is re established by artificial respiration the vicious circle is broken huge amounts of air may be disposed of by rapid absorption or elimination after which the animal or patient is none the worse for his experience.

SYMPTOMATOLOGY

When air under pressure enters a vein of considerable size a characteristic gurgling hi n sound or *sifflement* may be heard. It is due to the entrance of air from the inflated bladder or urethra into the veins. When absorption takes place through a group of capillaries or by way of the renal pelvis this diagnostic sound may be absent. No matter how small an amount of air has entered the heart by way of the venous circulation there is a fall in the blood pressure dyspnoea and restlessness. This may be followed by syncope from which the patient soon recovers none the worse for his experience. Unquestionably these early symptoms are often overlooked or mistaken for other conditions. If a larger amount of air even in some instances as little as 15 cubic centimeters has entered the patient is seized with a sudden terror coughs becomes more dyspnoic develops severe anæmia soon followed by cyanosis. The eyes become fixed the pupils dilated. The patient may complain of nausea and an acute pain in the epigastrium and precardium. The respiration ceases the heart action becomes irregular and often tumultuous the pulse becomes more accelerated and rapidly sinks while the patient goes into profound syncope which is terminated by convulsions of a tetanic character or a violent cough.

DIAGNOSIS

If during the inflation of the urethra or bladder with air the patient suddenly complains of pain becomes dyspnoic and cyanotic develops a rapid pulse and heart action accompanied by lowering of the blood pressure and goes into syncope air embolism should be suspected at once. The characteristic hi n sound *sifflement* may be absent but when present is pathognomonic of the entrance of air into the venous system. Auscultation of the heart will often reveal the characteristic whir *bruit de soufflement* due to churning of air in the chambers of the right heart. Likewise a number of mucous rale can

often be heard in the lungs due to the presence of air emboli. In some cases it is not uncommon to find local emphysema or infiltration with air of the tissues surrounding the urethra or bladder.

TREATMENT

If an air embolus is suspected one should at once release the pressure under which it is being injected into the bladder or urethra. Many cases let alone will recover but in order that any form of treatment shall be effective it must in the majority of cases be quickly applied. As it has been definitely proved by animal experimentation (Blair and McGugan) that the heart continues to beat after respiration has ceased artificial respiration in which pressure on the thorax is exerted during expiration should be resorted to and continued even while other measures may be used to resuscitate the patient.

On account of the rather deep position of the venous plexus draining the bladder prostate and urethra direct withdrawal of blood from the veins containing bubbles of air as advocated by Kleinschmidt cannot be made. It might be stated in passing however that venesection is a valuable procedure particularly in those cases in which air has entered the veins of one of the dependent members of the body.

The usual cardiac stimulants consisting of the different forms of digitalis, caffeine, camphorated oil, etc. should be employed. The best stimulant of all is the injection of adrenalin into the right heart itself. This consists of injecting cubic centimeters of 1:1000 adrenalin solution through a fine needle that has been pushed through the chest wall and lungs at the anterior extremity of the right third or fourth intercostal space. Opening of the thorax and direct massage of the heart although drastic has been used with success.

In 1910 von Lesser attempted to sweep the air from the right heart into the pulmonary circulation so that the impact of fluid against the tricuspid valve cusps would cause them to close in the normal manner. He therefore employed simple infusion of 0.5 per cent sodium chloride solution and reported good results from its use. In experimenting on animals Blair and McGugan and others not only found its administration of no benefit whatever but actually dangerous because the already weakened heart tends to dilate if additional fluid is added to the circulation.

The most rational form of therapy is the prevention of entry of air into the venous system by the abandonment of its use in inflating the urethra and bladder for diagnostic and operative purposes. One should abandon the common practice which

consists of injecting analgesic or antiseptic solutions into the bladder by forcing open both sphincters with an air cushion obtained by compressing the bulb of the common aseptic urethral syringe. Water can be readily substituted for air for the purpose of inflating the urethra and bladder in performing cystoscopies and in making cystograms. Antiseptic solutions such as mercurochrome, rivanol, boric acid, etc. can also be used in place of air in inflating the bladder to facilitate its surgical attack.

DISCUSSION

In reviewing the factors that led to a fatal termination of the case reported herein and which might have happened in any patient in whom the bladder had been inflated with air, I wish to emphasize the following points. The ulcerated mucosa overlying the adenocarcinoma that was found to have been present in the base of the bladder offered an excellent portal of entry for air into the veins of this new growth. Had the surface of the vesical mucosa been intact the small amount of pressure utilized in inflation of the bladder would never have caused air to enter the venous circulation. Increase in intra-vesical pressure was favored by the encroachment of the enlarged prostate which prevented regurgitation of air to the outside between the wall of the prostatic urethra and the catheter. The probability of the entrance of air into the circulation by way of the pelvis after having ascended the ureters from the bladder was not likely to have occurred in my case because the characteristic *sifflement* produced by the entrance of air into the veins of the bladder was heard. The advanced sclerosis of the coronary vessels might have aided in stagnation of the cardiac circulation causing anemia and deterioration of the cardiac muscle and favoring sudden arrest of the heart action because neither the heart beat nor the pulse was perceptible two seconds after the patient had become convulsed and cyanotic. It is also probable that the air might have passed through the lungs into the cerebral circulation thus causing anemia of the respiratory center in the bulb producing respiratory failure. These factors which coupled with the patient's familial and individual predisposition to the formation of gaseous emboli which varies enormously in individuals and in different species were responsible for the sudden fatal issue.

SUMMARY AND CONCLUSIONS

1. Distention of the bladder or urethra with air or oxygen for any purpose may result in

TABLE IV.—SUMMARY OF CASES

| R f h | S | D os | I r | P h l l | Sym m l s | Phy l s | T m | R l | A p y |
|-------------|------------------------------|---------------------------------------|---------------------------------------|-------------------------------|----------------------------|------------------------------|--------------------|------------------|--|
| P A J | M 1
57 | V l l l | I 0
6
l m
l f l | A l d y t f
h h
b l d d | | H d s f p | A 5 l | S d d h | A P
C l h t m y
p f m d l l y
d w t d l |
| E G B H z | M 1
7 | F p h r | C g r p h y | T m u d p o
h h
b l b y | F d b r | C H | A f l g m
l t | D t h | |
| L B t | M 1
6 | A l m f r | I f h b l d d
w t h p t
t l m y | | D y p a c | D y p h p d p l | | D h s | |
| W n h | M 1
6
f m l
d d m l | B l d d t m | C g r p h y d
C s f l p y w t h | B l d d t m | D y p a c m l | C p l t f p
p b u s | A p l f t m
f t | O d t h
d w | |
| A C h t | M 1
4 | | U h p d p
h r | U l w m | S m s l b d
m f f b g | R p d d k p l | | R y | |
| W m F | M 1 | U h r t r | L h p y t h
x | T l p d s f m
m l t | S t f m s
t h g t h g h | S l l g p m
f h g h | | R a c t y | |
| A G l d t m | M 1
53 | C p o a t m
f r l a c a l g
C s | I f h b l d d
w f p m y | G h l l f m
b l d d f p | | S d d d h | | D t h | |
| B G | M 1 | B l d d t m | I f h b l d d
m l f t m | B l d d t m | S b f t p
d y p | L s e f b l o o d
p l p d | | D t h | |
| G M | M 1
6 | P o s h y r | I f h b l d d
s t t m | T C l g h
k d y | R p d p l s
p | F m p h m f p
l t | | D h | A l b h t
f j
c m n |
| G M | M 1 | P b h y r | I f h b l d d
w h m y p | A s | R p d a n | | | D h | A y |
| T C M k | M 1
3 | I f d f l l | L l o s p y w h
p | I l l d h l l l | P t r m
h o s f l | W h e r t h d l
l f p h | A 5 l | R d y | |
| A M d | M 1 | U | I s b | A b m f h
m p d | G l l l a c | D l d l f l | A u 5 l
m l | R c o r y
m m | |

Personal name

TABLE IV—SUMMARY OF CASES—Cont and

| R f th | S I g | D g | D g l p d | P th l l m g l m l o l | Sympt m t l g r | Ply l | T m t | R l t | A t p y |
|-------------------------|--------|-------------------------|-------------------------------------|------------------------|-------------------|---|-----------------------------------|---------------|-------------------------------|
| J L M g | M l 35 | D t c u l m l d | C y f g r m j t t m l y | O h t t m b | P H d p p t | R p d l d p l | | D t h | |
| G N l h | M l 73 | P t t c h y p t p h y | I f t b l d d m m p t t m y | D l t d d p t t t h | P d l p | S d l t f t g h | | D t h | B d l f t i c a |
| I P t h | M l 7 | H y p t p h y p o s t t | I f t b l d d m m p t t m y | | | S d l d t h | | D t h | |
| S k | M l 6 | B l d d m | R t f t m | B l d d m | S d l h k g d p a | C y p l l p k d | A t f l p | D t h | A d s t h f t |
| L D S m | M l 65 | P p l l m f b l d i | C y t g l h y | B l d t m | C l l l b r a | G d l f d | | D t h | |
| A R s t | M l 65 | C b l d d m | I n f t b l d l m m t m y d f l | B l d t m | D y p l l r | R p l r l l p | | D t h | |
| J V t t | M l 65 | C b l d d m | P t l s t t m y | S j g h m d l | S d d d t t | C l l t h | | D t h | |
| A C V k W t d t B d p t | M l 54 | C b l d d m | U t t p y t h | | D y l a | R p d p l l p | | R l f t d t h | A t h s t d t t p y |
| A W l l | M l 50 | B l d l p t l l m | F l c t t p p l l m m t t l y d l d | P p l l m f b l d d | E p l g u d g | C y d y p a y m t p d p l p l l p l g b l o o d p | O g e | R s m | |
| H W t h | M l 85 | B l d d m | C y t t m y | V l b l d d m | | R p d p l | | S d l d t h | |
| R W d | M l 68 | U t t t | U t t p y t h | L t t f m t t g t h p | C y w e l | R p d p l | A t f l p t d p h g m d m s f h t | D t h | A d h t t t p l m f N l l d d |

P Add t l m m t r d l y W B t S W m k g t M J b (s) I J W s b t t d t l l l b t l

transitory or grave symptoms should it enter the venous circulation

A fatality is herewith reported which was proved at autopsy to be due to air embolism following the inflation of the bladder for an operative procedure

3 Increased intravesical and intra urethral pressure is favored by prostatic hypertrophy as was noted in this case or by stricture formation which prevents the escape of air between the walls of the urethra and the indwelling catheter or cystoscope Rupture of the vesical mucosa by overdistention or the presence of a pre-existing pathological lesion such as marked inflammation ulcer formation or a new growth weaken the bladder wall thus favoring the entrance of air into the venous circulation

4 Undoubtedly mild symptoms consisting of restlessness transient changes in the respiratory and cardiac action have been overlooked as has also the cause of fatal termination in such cases Death is due to the arrest of the pulmonary circulation to gaseous distention of the right heart thus preventing function of the tricuspid and pulmonary valves to little blood reaching the left ventricle so that anemia of the vital centers of the brain is produced and to stasis of the coronary vessels

5 The most effective treatment of air embolus is the immediate release of air pressure in the bladder artificial respiration and injection of 2 cubic centimeters of 1:1000 adrenalin solution directly into the right heart

6 Air in the bladder and urethra should be used with the greatest caution Inflation of the urethra and bladder with air for diagnostic therapeutic and operative procedures should be abandoned and harmless sterile water or mild antiseptic solutions substituted

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 COU o s C Bl f s hw iz A tze 88 5
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 C mpt re d S b l 1875
 LARNE E R S 6 Gyn & Ob t 9 5 533
 LES ER L vov Z t l bl f Chr 9 v vii 33
 LEV IN L a d GOLD CHMIDT H D t h med W h
 schr 897 v 60
 LEWIS Q ot d by N l h
 M GENDIE Les ph mè e phys q d l se t l
 Lec vi 84 54
 MANAURAY G l g ts méd 188 3
 MARJOU G J d r l 9 3 iii 4
 MARK E G J Am M A 9 l 419
 MO GAGNI J B D popl qu l q e a g
 se est rm hab t De S dbu te m borum
 779 v 69
 NICOLICH G J d l 9 3 iii 45
 OILMAN I L D u g p p r f v k v Fity 3 ns
 of p es n the t me t f g he J Am M
 A 925 lxxv 1609
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 QUILLOT H R ch hes xpénme t l l mbol
 gazeuse P ris 9 6
 REVE STORF S Fo t hr a d Geb d R ntg trahl
 908 2
 SANTIN C So m d h di B lg 9 3 J ly 26
 SAUGHMAN CH B it z Kln d T be k 9 4
 Von B au 57
 SCHLAE FER K Joh H pk H p B ll 9 v x 3
 SENN N An perum nt l d l l t dy f emb
 Isem Tr Am Su g As 88 1 97
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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.
ALLEN B. KANAVAL, M.D.

Managing Editor
Associate Editor

WILLIAM J. MAYO, M.D.

Chief of Editorial Staff

MARCH 1979

CRANIAL INJURIES

WE have never had a very clear understanding of the pathology underlying concussion and contusion of the brain. There is one factor however that until recent years has not received sufficient attention. It seems reasonably certain that after a blow on the head sufficiently severe to produce unconsciousness there is a primary anaemia lasting for a very brief time followed by oedema which may be very slight and easily absorbed. If there should be more than an easily absorbable amount, an increase in intracranial tension is brought about since the brain in adults is inclosed in a rigid skull.

This acute increase in intracranial tension then becomes of prime importance meaning life or death to the patient. All head injuries should be managed so as to bear this essential feature in mind. Unfortunately the picture is often complicated by a secondary factor which commonly receives more than its share of attention in routine hospital work. I refer to such complications as fracture of the skull itself, extra or intra dural hæmorrhage, infection etc. Each of these complications

presents definite well known indications for treatment.

In 1924 my associate, Dr B. B. Neubauer and I felt that it would simplify the management of head injuries if we could classify such injuries as a whole according to what we had come to believe was their essential feature—*intracranial tension*. Our cases readily divided themselves on this basis into three groups: (1) no increase in tension, (2) moderate increase in tension, and (3) marked increase in tension.

At that time we were doing many spinal punctures finding that the cerebrospinal pressure reading fitted the clinical picture so regularly in these three groups that we now reserve spinal puncture for the cases concerning which there is any diagnostic doubt or in which it is desirable to use it as a therapeutic measure. The details of the varying clinical pictures as they progress from no increase to a marked increase in tension with the management of each of these groups may be found by those interested in our original article on this subject.¹

Since this time others have taken similar viewpoints in the management of cranial injuries. We have found this plan based as it is on the control of this all essential feature—*intracranial tension*—greatly simplifies the problem which I must confess was often quite confusing when we were thinking in the terms of concussion, contusion and compression.

The majority of head injuries about 70 per cent will fall into the milder groups of increased tension and will respond to the

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non operative plan of management if no complicating factor arises. Of the remaining 30 per cent about one half will also respond to non operative treatment but in our experience some 15 per cent will fail to do so. In the latter group we feel sure that subtemporal decompression is indicated and in some cases it will unquestionably relieve tension sufficiently to tide the patient over the emergency. It is of prime importance that the patient be kept under observation and treatment for a sufficient length of time. We believe that such sequelæ as headache dizziness and even Jacksonian epilepsy may be averted if this be done.

J STEWART RODMAN

SOME RECENT EXPLORATIONS IN THE FIELD OF VISCERAL NEUROLOGY

THE exceedingly complex nature and the remarkable autonomy of the physiological processes has fascinated man from the earliest times. How much accurate knowledge of the physiology of the nervous system has been lost with the passing of ancient peoples as is maintained by some writers to be the case we do not know. However we do know that within the period of recorded history our knowledge of this subject has grown by exceedingly slow degrees. No sooner has an apparently established fact been accepted than it has had to be abandoned. It is with reluctance that we ever admit the uncertainty of our position and retrace our steps to where we started. Fortunately for our self respect however we can usually find a new foothold as we relinquish the old. The very spirit of science forbids us to mark time knowingly.

It is not so long since it was first observed that stimulation of the vagus slackened the pace of the heart. Such a result was beyond

the comprehension of our medical forbears. Notwithstanding anatomical facts to the contrary many of them weakened and denied that the vagus nerve had any connection with the heart. Indeed most of us fall into the ways of Hamulcar's ancient pilot who when compelled to report the loss of his fleets to his stern master offered the excuse that blood red toads and seaweed filled the horizon.

We continue to pursue the study of physiology with rapt interest and sometimes not without dismay. At the present time a Magellan of physiology who now has reached the ominous age of 78 years holds the attention of Europe. Pawlow's new books *Conditioned Reflexes* and *Activity of the Cerebral Hemispheres* translated by one of his former pupils Anrep of Cambridge will soon appear in English.

Pawlow's earlier work on gastric pancreatic and salivary fistulæ and the observations made on his miniature stomach are well known. The more recent investigations of his school have been sketched in outline by Gantt.

Pawlow considers all acts as reflex and distinguishes between inborn reflexes and acquired psychic reflexes. Noting the psychic flow of saliva he sought a method of measuring this psychic activity. In order to eliminate every external stimulus he had his laboratory surrounded by a moat several feet deep filled with sawdust to intercept vibrations from the street. The working rooms were widely separated built of walls 2 feet in thickness and guarded by iron doors padded with rubber. Dog and operator were likewise separated. The dog's cell consisted of two shells of concrete the inner one suspended by a huge iron hook within the outer one. By

the G W H R t w k f P l w d b p l d t o e d
n d (Sp m h an ky) Ar h N l & P y h t 9 7 x v s 4 5 8

means of an electric switchboard the experimenter communicated with his subject and could give the conditioning stimulus skin irritation light odors and sounds, he could also feed the dog without being seen and could observe his subject through a periscope. The response of the dog was determined through the flow of saliva which was measured by a manometer and recorded on a drum. Usually food was used as the unconditioned stimulus but an electric stimulus to the paw could be used in which case the corresponding foot was suddenly raised at the proper time after the conditioning stimulus had been applied.

The conditioned stimulus for example light must be given before the unconditioned stimulus for example food and the two must be associated 20 or more times depending on the animal and other factors before the application of the conditioned stimulus alone suffices to produce the result for example a flow of saliva.

Some interesting psychic responses were noted. For example if a circle was presented as a conditioned stimulus (followed by food) and an oval as a negative conditioned stimulus (not followed by food) and later a figure midway between the two was presented the animal might whine refuse to eat become drowsy or excited and present an array of symptoms referred to by the writers as neurasthenic.

Other animals such as fish may be used and it is interesting to note how well these dull pupils distinguish between red and green lights. Mice may readily be conditioned in such a manner that they will scamper into the dining room at the ringing of a bell just as the pigeons of Venice come flying to the piazza of St. Mark's from all points of the heavens at the stroke of eleven, which for centuries has been the hour of feeding.

Krasnogorski, one of Pawlow's older pupils, Ivanov Smolensky¹ and others have found in their study of conditioned reflexes of children that the skin analyzer begins to function at 3 months and that infants can distinguish between the odors of camphor and cologne at 8 months. They have also observed that an idiot may have the level of a fish and that neurotic children may develop and lose conditioned reflexes more quickly than normal children. This work has been extended to other psychiatric conditions.

Whether this work and other researches carried on in Russia will cease with the death of the master as has been freely voiced in several European clinics remains to be seen.

Workers on the physiology of the nervous system elsewhere however are not idle² and the tremendous impetus given to the study of the visceral nervous system by the work of Hunter and Royle has resulted in the opening of an entirely new vista in surgery which promises to equal in importance and usefulness the crowning achievements of general surgery of today.

Raynaud's disease has defied satisfactory treatment for years today the pain and gangrene in their usual manifestations may be relieved at once by sympathectomy³. Thromboangitis obliterans bled its victims and gave no quarter now the torturing pain at least may be made to yield at once in cases selected according to the vasomotor response and the ulceration usually shows some improvement⁴. In Japan where leprosy is rampant it has been found as Professor Shimosaki informed me that acral pain and

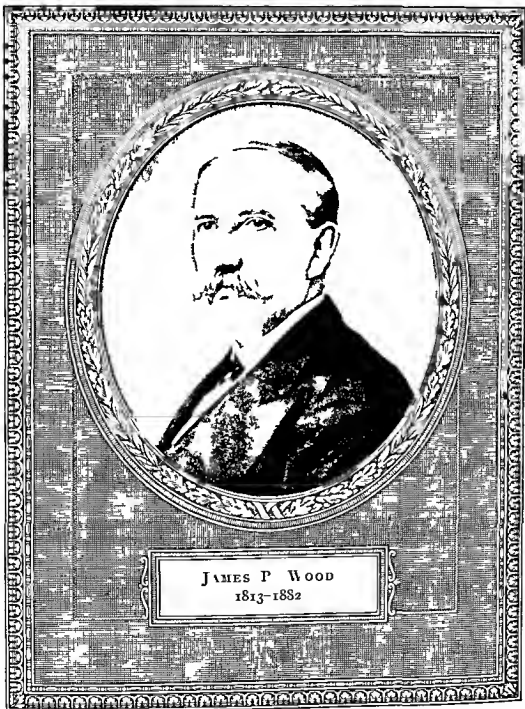
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9 Ad A W s g l l f f R y n d d i s d th v s c l
d t b h y y m p t h t E G l t o m y d p s c l a
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ingrained which are not uncommon may be combated by sympathetic neurectomy and amputation thus affording these unfortunate patients much comfort. It is hardly an idle speculation that essential hypertension¹ bone disturbances such as osteoporosis² and other disorders which so far defy our best efforts will some day be relieved.

The surgeon who would advance this frontier however must be thoroughly familiar with what is known and what is unknown of the anatomy the physiology and the pathology of these structures he must possess wide technical knowledge and the ability and patience to use it he must be courageous but not foolhardy and must be ready to view his own disappointments and those of his colleagues with a spirit of cooperation and charity.

HENRY W. WOLTMAN

1. R. F. L. G. J. A. M. A. W. B. I. 11. m. b. 6. m. h. m.
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JAMES P WOOD
1813-1882

MASTER SURGEONS OF AMERICA

JAMES RUSHMORE WOOD

JAMES RUSHMORE WOOD was born at Mamaronck New York on the 14th of September 1815. Surgeons operating in this year of grace 1929 have little idea of the chaotic state of surgery not only in America but throughout the whole world in those pre-esthetic and pre-aseptic days. When Dr. Wood began his medical work in 1829 just one hundred years ago surgery was beginning to be recognized as a science for it was not until after 1800 that the surgeon began to have recognition or any standing whatever. It was in that year after much difficulty the Royal College of Surgeons of England obtained its first charter. In the House of Lords even at this time it was said in open discussion that "there is no more science in surgery than in butchering."

It is only necessary to remember that a little over a hundred years ago there were scenes enacted in the name of surgery which eclipsed in horror the frightful cruelty of the Spanish inquisition the untold miseries of the Bastille the indescribable sufferings of the Black Hole of Calcutta and the excruciating pains of the Turkish bastinado and the cruel massacre of the Huguenots. Patients were held down upon the operating table by brute force and were operated upon while in the full possession of their senses they were heard to cry out in heart-rending screams for a discontinuance of the tortures they were incised with red-hot knives and they were compelled to have their wounds dipped in a caldron of seething tar to control hemorrhage. (Dennis) This is quoted only to impress upon our minds that the call to be a surgeon in the year 1829 when Dr. Wood began his career must come to a man of unusual qualities. The times were to us unbelievably backward for at this date the large cities in the United States were even using tinder and flint to light their fires and the first railroad did not operate by a steam locomotive until 1831.

But Dr. Wood was a man of unusual qualities. We cannot judge him by our present-day standards. We must judge him by the use of the tools and by the environment that obtained in that age and after we have studied his work his accomplishments and his great fame—for he was *the* famous surgeon of the famous (Bellevue) hospital in America in his day and generation. Surely we can after reading of his life say truly—Here was a *man* and—Here was a master surgeon!

Dr Wood's family were Quakers a sect that has often produced genuine men. He had meager schooling. He never enjoyed a college education. He attended his first course of medical lectures guided by his preceptor Dr David L. Rogers at the College of Physicians and Surgeons located in Barclay Street New York about the year 1830. Can any of us who know the present College of Physicians and Surgeons as the great Medical Center now sweeping the skies at 168th Street New York imagine a medical college in Barclay Street? But he graduated at Castleton Vermont in 1834. Dr Wood then began his practice in the Bowery but fire soon involved the destruction of his home and all his books instruments and specimens. This was a serious loss to him. But as Osler wrote to Trudeau after a similar experience and disaster: Dear Trudeau I am sorry to hear of your misfortune but take my word for it there is nothing like a fire to make a man do the Phoenix trick. And Dr Wood did it. He moved his office to Broadway and he married Miss Emma Rowe daughter of James Powe a retired merchant and in due time had one son and two daughters. His practice grew apace. Aside from his general practice and his surgical work he brought into the world many who afterward became our leading financiers and citizens.

Dr Valentine Mott Dr Willard Parker Dr Alonzo Clark were prominent contemporaries.

Dr Wood will always be associated with Bellevue Hospital. This celebrated institution goes back even to the date of 1658 and is noteworthy as being *the first hospital in the civilized era of American history* when the city of New York numbered only one thousand souls! The first fifty years of the nineteenth century are not happy years to record for this institution. The four wild horsemen of Death Yellow Fever Smallpox and Typhus Fever dashed back and forth over the young institution. It was difficult to provide adequate nursing. As convicts and insane were kept in the same institution the insane patients were nursed by the convicts [a wonderful arrangement!]. At one time out of 54 confinements 8 died! What do we think of such mortality as this: phthisis 74 per cent delirium tremens 25 per cent puerperal fever 85 per cent?

At this time there arose a young man aged 34 Dr James R. Wood who with the co-operation of Dr Willard Parker and Dr Metcalf saved the doomed institution for an indignant city was about to pull it down. By his courage and industry he swept the Augean stable. He had ever been a keen politician (an intimate friend of Henry Clay) and he knew how to manage the politicians for Bellevue was then a political job.

One of the great services which Dr Wood rendered to medicine was that he was chiefly instrumental in the passage of the act granting for anatomical teaching the bodies of all vagrants dying unclaimed. His position as demonstrator of anatomy in 1837 enabled him to see the wisdom for this act as previously medical

students had been compelled to be known as body snatchers or as our Scotch confreres termed it "resurrectionists"

Dr Wood's celerity in operating was acquired in the days before ether or any anesthetic (except alcohol) was employed. He practiced surgery for 10 years before 1844. He quickly learned to cut with equal skill and precision with either hand. He took more than a little pride in his speedy work. Frederick S. Dennis, who was later associated with him as a partner and is still living in New York in good health, says that Dr. Wood could amputate the thigh in *nine seconds!*

One of Dr. Wood's house surgeons in the early days at Bellevue, also still living in New York, Dr. Henry Mann Silver, writes that James Rushmore Wood was a man of wonderful personality, a great anatomist, a rapid and skillful operator whose results were brilliantly successful. He had great powers of clinical observation and diagnostic acumen. His energy was unfailing and he was always on the alert to detect and combat any unfavorable sign. The tripod on which he rested his treatment was rest, cleanliness and free drainage. Although stern and unyielding on the professional side, he always carried with him the warm and helpful side for all those worthy of it. His house staff, private students and patients adored him. He was an inspiration never to be forgotten. A wonderful tribute!

Now before we review his particular and special contributions to surgery, let us read what he did for humanity and the nursing profession while he was at Bellevue Hospital.

In 1869 was inaugurated at Bellevue Hospital the *first ambulance service for cities*. Although Dr. Dalton was the chief mover in this service, he could never have accomplished it without the backing of James R. Wood, then practically chief of staff. Dr. Wood brought to bear his wonderful personality and his pull. 'This ambulance service was so perfected in discipline and detail that it has been but little changed to this day. The system has been adopted by the hospitals of the world' (1869).

A few years later, in 1873, greatly by the efforts of James R. Wood, another record maker was accomplished. The first training school for nurses was inaugurated for all America. Few will deny that this was an epochal event. Helping to start the undying life of the mother of all training schools should give undying luster to the fame of any man. Bellevue opened its Training School May 1, New Haven, October 1, Massachusetts General, October 1, (1873). How many training schools for nurses are there to-day? And how many surgeons must almost abandon their operative work without the help of the trained nurse!

Dr. Wood had an individual personality. Like some other great men we know, he was not averse to the spectacular. His students ever called him Jimmy Wood. It was not a term of disrespect, but only one of affection.

Before he entered the operating room he used to put on his long black gown over his street clothes. This gown was black so as not to show former splashes of blood and was buttoned tightly about his neck and wrists. On this gown above his heart Dr. Wood always pinned a red rose or carnation. Cheers always welcomed his dramatic appearance. His clinics began attended only by the orderly and one student. Later it was not unusual to see over a thousand students and doctors in attendance. He frequently almost emptied the clinics of other colleges and hospitals in New York the day he operated so popular and instructive were his clinical lectures and his surgery. It is with no disrespect to tell furthermore that his operating gown would often be festooned with needles threaded with waved silk (usually kept nobody cared where as long as they were at hand when required). As before stated Dr. Wood's early education had been meager but he felt that the dignity due to the profession required an occasional Latin phrase. One who heard him say it has told the writer that he would at times in admonishing his students to do meritorious work say to them most sententiously: "Remember that the eyes of the *rex populi* are always upon you. Few of us are without faults but few are loved for them as was James R. Wood."

Dr. Wood from the beginning of his connection with Bellevue in 1847 began to collect postmortem material with the intention of founding a museum. As an aid in the accomplishment of this object he offered prizes for the best anatomical dissections. He presented this collection in 1856 to the New York Commissioners of Public Charities and Correction. Thus was founded the Wood Museum. Dr. Willard Parker remarked that the Wood Museum as it now stands is the grandest monument ever erected to any surgeon in this country and the London *Lancet* speaking of its rich collection of antique specimens said: "It is not a little remarkable that this museum like our own Hunterian owes its origin to a distinguished surgeon whose work is known all over the world including especially some of the most beautiful and successful instances of operation for the reproduction of bone."

In periosteal reproduction of bone Dr. Wood had an international reputation and the renowned Langenbeck in an address said that he did not believe a corresponding preparation really existed anywhere (after a specimen of a regenerated lower jaw had been shown by Dr. Wood in 1877 before the German Congress of Surgeons in Berlin). England gave him recognition when the London *Lancet* at about this time said editorially: "Dr. Wood is entitled to great praise for having been one of the pioneers of periosteal surgery. American surgeons know only too well that neither English nor German surgeons were in the habit in those days of throwing bouquets to American doctors."

Dr. Wood excelled in cutting for stone in the bladder. Surgeons would flock to New York just to see him do this operation. He invented an instrument—a

bisector' — which he used with precision and dispatch. It is said that he seldom failed to produce a patient for this operation when requested.

Dr Wood's work on the arterial system was enormous. It is said he tied the femoral artery over fifty times. He ligated the carotid many times for the cure of aneurism and in one case the carotid and subclavian of the same side and he had by this procedure successfully cured an aneurism of the arteria innominata. In the early days of his professional life he had tied the subclavian artery five times in succession and in every case cured the aneurism. He tied for aneurism the external iliac eight times in succession and cured the aneurism in each case. He inaugurated the cure of aneurism by pressure.

In surgery of the nerves he was very successful. He removed Meckel's ganglion successfully four successive times. This too at a period when this operation was seldom performed.

Even in those early days he performed abdominal operations but he was prejudiced against the operation of ovariectomy preferring to refer cases of this nature to the gynecologists. In an *in memoriam* address read before the New York Academy of Medicine January 3, 1884 Dr Frederick S. Dennis who was intimately associated with Dr Wood for many years closed his beautiful tribute to the great surgeon (Dr Wood died May 4, 1883) with the following words:

'Dr Wood passed away in the unabated possession of his powers. His death was an interruption. It came to him in all the wonderful activity of his professional life but it came as he had always expressed a wish that it should come while he was still working. As it was he had accomplished an immense volume of work. For almost half a century he had been busily toiling for humanity; he always did what he could and that was much. Such a life is a lesson and an example. Fortified by the high professional achievements of Dr Wood this life must leave its impress upon the whole American profession.

JOHN HAMMOND BRADSHAW

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

WILFRED BROWN, M.D., F.A.C.S., OMAHA, NEBRASKA

THE WOUND SURGERY OF ARCEUS

DURING the Arabian period Spain, as the site of the Western Caliphate, passed through a period of surgical greatness, second hand so to speak, through the reflected glory of the Moorish physicians attached to the Spanish Caliph of whom Albuca is was probably the most important. About a century after his period in the middle of the eleventh century the Christian reconquest of Spain began and with it interest in the arts and sciences practically ceased. A very little of value came from the Arabian peninsula until toward the middle of the sixteenth century. Other countries had their wars which were more or less of the nature of family quarrels, but in Spain the war involved people of one race and religion against people of another and consequently it was much more bitter and for the time all other things were laid aside to the end that the people of Islam be driven from Spain. The Christian reconquest usually dated as the middle of the thirteenth century, but this date represents really only a restoration of the preponderant power and it was not until 1492 that the Alhambra fell and the last vestige of Moorish power was overcome. In the meanwhile the several smaller political entities

Spain were joining together, to the two kingdoms of Castile and Aragon which were finally united in 1469 by the marriage of Ferdinand of Aragon and Isabella of Castile. Under the Catholic sovereigns the country now began to advance rapidly and Spain soon became for a time the most prominent country in the world through its newly discovered colonies across the seas and the wealth thus brought to it from America.

With the fall of the Alhambra in the last decade of the fifteenth century and the affluence following the discovery of America the arts and sciences began to come into the revival. Early in the sixteenth century the University at Alcalá became a noted school and medicine according to the Hippocratic doctrines was taught also at Saragossa, Valladolid, Sevilla and other important universities but the instruction was almost purely theoretical. There was however in the province of Extremadura at the Monastery of Guadalupe a school devoted to clinical instruction which had the special privilege of carrying on anatomical dissection and Francisco Arceo received at least part of his instruction at this school for he cites a case that he observed there in 1516.

Francisco Arceo was born in Fegenal in 1493

According to some authorities he obtained his education at the University of Alcalá de Henares and later went to Guadeloupe. He gained a most excellent reputation as a surgeon and attained a large practice in the country drawing patients from all parts of southwestern Europe to his residence in Llerena in the Province of Badajoz. Apparently he did no writing until late in life for his work written at the request of the clergyman Benito Arias Montano did not appear until 1574. In the preface dated May 1573 Montano states that Arceus was still alive at this time almost eighty years of age but possessing the same skill and manual dexterity of a man of forty. When he died is not known.

This work for the publication of which Montano and a Spanish physician Alvarus Nonnius were responsible is divided into two parts, one on wounds and one on fevers. The first edition as published in Antwerp in 1574 printed in Latin. It was printed in English in 1588, in German in 1614 and later and in Dutch in 1667. The second Latin edition, the frontispiece of which is reproduced appeared in 1658. It is a page reads: Concerning the correct method of healing wounds and two books of other precepts of that art by Franciscus Arceus of Reginal doctor in medicine and surgery author. By the same concerning the method of curing fevers. At Amsterdam. From the house of Peter vanden Berg in the street (called) de Blaueburgwal under the sign of Mount Parnassus in the year 1658.

The surgery does not follow the usual form of the surgeries of the period. Arceus quotes the older authors and differs from the majority of the writers of his time refers to new authors and contemporary being particularly fond of John de Vigo. He then branches out from the precatory form and aside from taking up surgical details begins with the head and proceeds to the feet goes his own way and writes in a simple conversational style which is most refreshing. He tells the results of his own experience and is also a little practical. In some instances the treatment of penetrating wounds of the chest he differs from the generally held opinions and plainly says so, clearly explaining his own method of treatment. At times he digresses from the consideration of wounds and takes up other subjects. His treatment of clubfoot is interesting and the illustration of his home machine brace to attach to the shoe though not handsome looks like an efficient piece of apparatus.



Amstelodami
 Ex officina Petri vanden Berge in vico (vulgo)
 de Blaeuweberg wal / sub signo montis Parnassi
 1598

REVIEWS OF NEW BOOKS

IT is impossible to paint the holy, it is difficult even to express one's entire mental and emotional reactions to Dr. Cushing's style of expression. His thoughts are expressed simply and with a charming facility which no other writer of American surgical literature today possesses. His ability to say what he has in mind in a relatively few words and consequently in a comparatively short time must make him a godsend to the harassed arrangement committee for dedicatory exercises and like functions. The addresses in *Consecratio Medici*¹ are the result of a devotion and love for the matter in hand. It requires something more than these, however, to obtain a response from a reader who had no active part in and no relation to the exercises of the day upon which they were given.

The book consists of fourteen essays which reflect the wide range of Dr. Cushing's interests and connections. The character portrait of Samuel Garth, the Kit Kat poet and the chapter on "The Doctor and His Books" are evidence of the author's bibliophilic accomplishments. Perhaps unwittingly but just as certainly he has baited and set the trap for those young men who have had a longing for books and who until their association with him have dissipated their efforts. Realignments in Greater Medicine, The Personality of a Hospital and The Clinical Teacher and The Medical Curriculum contain Dr. Cushing's views upon the question of medical education. I wonder why he has not performed the obvious experiment upon some youngster entering medicine! Certainly volunteer experimental material would be plentiful.

The volume also contains an eloquent tribute to Lister and an understanding essay upon William Osler the Man. It becomes more obvious each day how many characteristics the master clinical teacher and his pupil have in common. Dr. Cushing's influence upon the young men associated with him will be as great and far reaching as was that of Osler and then the monument they leave to medicine and surgery will be exact replicas.

Perhaps before now it will be clear that I feel that this work is indispensable to the doctor whose hobby is books.

LOYAL DAVIS

BASED upon Sollmann's Laboratory Guide in Pharmacology, this new work in *Introduction to Experimental Pharmacology* has been built up with the thoroughness characteristic of its authors. The first ninety pages are devoted to chemical pharmacology, including materia medica, prescription writing and toxicology. Experimental pharmacodynamics is dealt with in 141 pages.

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Appendices covering 65 pages are not the least valuable feature of this volume. They include lists of equipment needed, methods of administering anesthesia to laboratory animals, different types of physiologic salt solutions and the admirable list of doses for animals which includes the toxic and physiologically effective doses of most of the important drugs. It is thus an excellent reference work for research workers in many fields.

Many of the experiments listed are commonly performed in the courses in physiology and physiological chemistry, but the material remaining should be ample. This volume is well adapted to the needs of those who find it difficult to secure dogs for mammalian work. The experiments which the students perform upon themselves should be noted. No type of teaching is as effective as personal experience with the effects of a given drug. Explanations and discussions which should be of much value to the student accompany each action but no attempt is made to do the student's thinking for him as is shown by the questions appended to many of the experiments.

CARL A. DRICESTER

ALL who have read the series of Masterpieces contributed by Alfred Brown to *SURGERY, GYNECOLOGY AND OBSTETRICS* will welcome this beautiful volume of historical surgical gems. It is apparent to the reader that the work has been a real joy to the author and he identifies himself among those bibliophiles who love and venerate the works of the blazers of trails.

The book consists of forty-eight sketches—one might wish them longer—of early contributions to the science and art of surgery. Some deal with well-known names while others here and there tell of the fundamental contributions of some less well-known authors. Each sketch brings to the reader the atmosphere of the ancient writer with his quaint sayings—with a picture of the state of scientific knowledge of the time. Dr. Brown has approached each of his authors from the standpoint of contemporary history and further illuminates these worthies through citations of comparative doctrines. The atmosphere of the book is scholarly, not argumentative or doctrinal and each sketch is a model of conciseness. One may follow the browsings of the author and relive the surgical achievements of Guillemeru, John de Vigo, Thomas Gale, Della Croce, Ieter Lowe and scores of others.

Himself an amateur binder of no mean skill, one might wish that Dr. Brown had added brief notes here and there on the bindings of some of the old volumes. The necessary brevity of the sketches no doubt precluded this addition.

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PRIMARY NERVE TUMORS OF THE NECK AND MEDIASTINUM

WITH A REPORT OF THREE CASES

G W CRILE MD FACS AND R P BALI MD CLEVELAND OHIO
CL 1461

P RIMARY nerve tumors of the peripheral nervous system are relatively rare with the exception of the type described by von Recklinghausen and the neurogenic sarcomata of Ewing. Because of their comparative rarity it has occurred to us that it would be of interest to offer a report of three cases of tumors in the neck and mediastinum which are related to the sympathetic and spinal ganglia together with a review of the literature pertaining to tumors of this type.

CASE REPORTS

CASE 1. The patient a man 51 years of age came to the Clinic on March 9, 1927 because of a tumor mass in his neck which had been present for 20 years. During the preceding 3 years he had suffered from shortness of breath a sensation of pressure in the chest and general weakness. He had no pain or cough. His family history was irrelevant.

Physical examination revealed a well developed muscular man 6 feet in height and weighing 195 pounds. The skin was of good texture the hair was normally distributed and the eyes were normal with equal pupils which reacted normally. The nose was normal. The teeth were in a poor state of preservation and the tonsils were enlarged. The tongue was clean and on protrusion it remained in the midline. The neck was large with a bulging tumorous mass on the right side about 12 centimeters in diameter firm and extending below the clavicle (Figs 1, 2 and 3). The skin overlying this enlargement was not adherent. The chest was symmetrical and the respiratory excursions were good and equal. There was a dull percussion note at the apex of the right lung. The area of retrosternal dullness was 12 centimeters

in width. The breath sounds were normal. The apex beat was at the left nipple line. The pulse rate was 78 in both radial arteries. The systolic blood pressure was 130 and the diastolic 74. There were no abnormal heart sounds. The veins over the lower portion of the abdomen were distended. A healed appendiceal scar was present. The liver and spleen were not palpated. No tenderness or tumor masses were found. Dilated tortuous veins were visible in both legs which however showed good muscular tone and strength. The reflexes were normal and there were no disturbances in sensation.

The laboratory findings were as follows: Urinary findings: acid specific gravity 10.2 no albumin or sugar microscopically clean. Blood findings: white blood count 8000 hemoglobin (Tallqvist) 80 per cent blood sugar 3 hours after meals 126 milligrams per 100 cubic centimeters. The Wassermann and Kahn blood reactions were negative.

Radiographic examination showed moderate hypertrophic osteoarthritis of the dorsal spine. A large dense shadow was present extending from the sixth cervical vertebra to below the second rib anteriorly and encroaching upon the apex of the right lung. The trachea deviated to the left (Fig. 4).

The patient was admitted to the hospital on March 9. On March 12 the tumor mass was examined through a low collar incision and was found to be firm lobulated and encapsulated and firmly fixed to the surrounding fascial structures. The right carotid artery was displaced to the left of the midline. A pyramid shaped nodule was removed for biopsy and the incision was closed. This nodule had a homogeneous fibrous cut surface. From the microscopical examination the diagnosis of neurofibroma was made. The patient was told that any further operative procedure would be attended with considerable risk and he was discharged on March 24.



FIG. 1 (Crile) Front view of neck showing tumorous mass extending below the clavicle



FIG. 2 (Crile) Lateral view of neck



FIG. 3 (Crile) Profile view showing tumorous mass at right side of neck

In childhood the patient had had many measles, chicken pox, whooping cough and tonsillitis. The only operation that she had undergone was a tonsillectomy in 105.

Physical examination gave the following findings: Height 5 feet 4 inches, weight 170 pounds, pulse rate 72, Systolic blood pressure 100, diastolic 68, Temp rectum 99 degrees F.

The laboratory findings were as follows: Urinary findings: acid, specific gravity 1005, no albumin or sugar. Blood findings: White blood count 10,300, hemoglobin (Fallqvist) 90 per cent, blood sugar 105 milligrams per 100 cubic centimeters 8 hours after meal, blood urea 33 milligrams per 100 cubic centimeters. The Wassermann and Kahn blood reactions were negative.

The patient was admitted to the hospital on October 17, 1927. At operation on October 18 a longitudinal incision was made parallel with the right clavicle and dissection was carried down to the tumor which was found to be a well encapsulated structure pyramidal in shape with the apex pointing upward. The tumor was movable but was attached at the apex to the median cord of the brachial plexus. At the base of it was attached to the prevertebral fascia lying in front of the sixth cervical vertebra (Fig. 11). The tumor was covered with a meshwork of nerve fibers. The carotid artery was superficial to the tumor. The tumor was dissected free and removed (Fig. 12).

Convalescence was uneventful and no sympathetic nerve disturbances were noted except slight paresthesia which radiated down the right arm on the fifth post-operative day.

Pathological report (Figs. 1-15): Ganglioneuroma and sympatheticotoma.

HISTORICAL NOTES

The first use of the term neuroma to describe deep seated tumors which are characterized by painful swellings of the nerve involved was made by Odier in 1803 (Wahl). The first reference to the production of a tumor by hyperplasia of a ganglion was made by Günsberg in 1845 (Spencer). In a tumor which was removed from the site of the gas-serian ganglion and was described as being of the size of a pigeon's egg, ten to fifteen times the usual number of ganglion cells were found. In 1863 Virchow classified nerve tumors as false and true neuromata. Three types of true neuromata were described: (1) neuroma gangliocellulare composed of ganglion cells with stroma; (2) neuroma fibrillare amyelinicum composed of non medullated fibers; and (3) neuroma fibrillare myelinicum composed of medullated nerve fibers.

In 1870 Loretz reported the first case of ganglioneuroma, stating that he believed that the tumor arose from a prevertebral ganglion. In 1915 Dunn reviewed the literature on neuroblastomata and ganglioneuromata and



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added cases to the 49 previously reported. In only 1 of these cases were the tumors situated in the cervical or thoracic region, the majority being found in the abdominal segment. In 1914 Wahl reported a case illustrating the three types of nerve tumor which arise from the sympathetic system and in his article he includes an excellent summary of the literature to that date. In Table I is given a brief summary of the reported case in which the tumor occurred in the cervical and thoracic segments. Recently (1927) Thomas has reported the occurrence of a ganglioneuroma in the abdominal segment of a cod fish.

HISTOGENESIS

It is presumed that the potential cell or group of cells which gives rise to a primary nerve tumor is carried from the ganglionic crest during the migration of the ganglia. This group of embryonic undifferentiated cells may remain forever quiescent or at any

period in the antenatal or postnatal development of the individual the cells may be in to proliferate. The resultant tumor will be composed of cells at various stages of differentiation, the stage of differentiation determining the degree of malignancy.

A working classification of the tumor should be based upon the cell types according to the stage of differentiation found as has been done by Bailey and Cushing in their classification of the glomata group. Such a classification can be made only by the examination of a large number of these tumors for different staining characteristics and by the study of the morphology of the cell. A modified incomplete schematic outline is shown in Table II which will serve to illustrate the differentiation and the possible source of the tumor cells. The term neuroblastoma is not used because it is more general and should include any tumor of nerve cell origin.

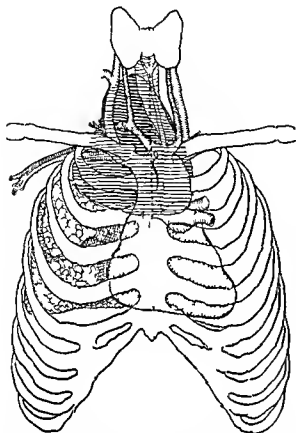


Fig. 5 (Case 1) Sketch illustrating the position of the tumor. Note that the right subclavian artery and vein are surrounded by tumorous masses.



Fig. 6 (Case 1) Mediastinal tumor removed at operation. Note the lobulation and network-like arrangement of tissue.

PATHOLOGY

In its gross appearance the sympathicoblastoma is usually a single encapsulated tumor which is round or oval when it lies in soft tissue and irregular in shape when it occurs in an area which will not permit symmetrical expansion. The tumor is covered with numerous nerve fibers which are attached to a nerve cord or nerve plexus. The consistency of the tumor is soft. In color the cut surface is pale gray, mottled with pale yellowish areas. At the cortex is found a distinct zone which is firmer and blends with the central darker portion. On microscopical examination large numbers of small round and fusiform cells are revealed lying in a delicate reticulum which supports numerous blood vessels. By special staining methods the cells are found to have the characteristics of embryonic nerve tissue.

The sympathicoblastoma is rarely composed of one type of cell but usually shows differentiated areas in which are found large oval cells with abundant faintly staining clear cytoplasm and round small deeply staining nuclei. These are the ganglion cells which are found in the ganglioneuromata. They may be much larger and are sometimes four times the size of a normal ganglion cell of the cerebral cortex. The cells are apolar, unipolar or bipolar. The stroma is a delicate abundant faintly staining structure supporting numerous nerve fibrils which are myelinated or amyelinated. Sometimes the nerve fibers can be seen to terminate at the pole of a ganglion cell. This structure does not stain properly for neuroglial fibers.

The neurofibroma is stony hard, is usually lobulated, nodular, well encapsulated and has a striated lusterless cut surface. Microscopical examination reveals linear deposits of



A



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1 4 (C e) A l t r m h w m d t l t m e t d f m t t h t h c l e t b
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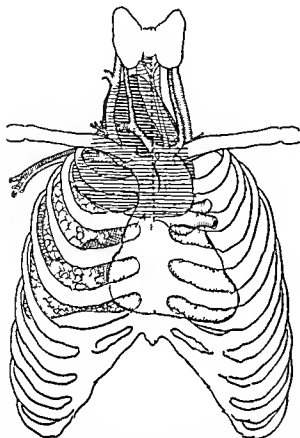


Fig 5 (Caer) Sketch illustrating the position of the tumor. Note that the right subclavian artery and vein are surrounded by tumorous masses.

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The neurofibroma is stony hard, is usually lobulated nodular, well encapsulated and has a striated lusterless cut surface. Microscopical examination reveals linear deposits of



FIGURE 1
The tumor cells are spindle-shaped and arranged in bundles.

flattened small cell with a very cytoplasm which appears to be compressed between numerous bundles of elastic and collagenic fibrils. The adjacent lymph gland or organ is not homogeneous except in the case of the undifferentiated type, namely the neuroblastoma or the sympathoblastoma.

DISCUSSION

Dunn has summarized the pathogenesis of the tumor which reports two cases, one of which occurred six years after the onset of a congenital neuroblastoma in the adrenal gland in a child four years of age. The clinical and histological features indicate that the tumor is a tumor derived from the sympathetic nervous system which have been displaced from their natural place in the sympathetic plexus of the nervous system. When the displaced cells return their original embryonic position a malignant tumor



FIGURE 2
The tumor cells are large and irregular, with prominent nuclei.

result. On the other hand ganglioneuroma is not malignant. A focus may not differentiate and take on malignant character.

Often a single tumor shows different stages of differentiation as occurred in our third case in which the tumor was both a sympathico blastoma and a ganglioneuroma. It is easily conceivable that all stages of differentiation might be found in a single tumor.

That a tumor of one type may be transformed into one of another type is well shown in a case reported by Cushing and Wollbach. Wright has described what is probably the most malignant type, a type which is found in various organs but the fact would suggest that the multiple growths are metastatic rather than coincident multiple occurrence of primary tumor.

We place the neurogenic tumor in the position shown in the diagram because it is found in an undifferentiated state and by comparison with the ganglion cell the cell of the neurilemma might be thought to be

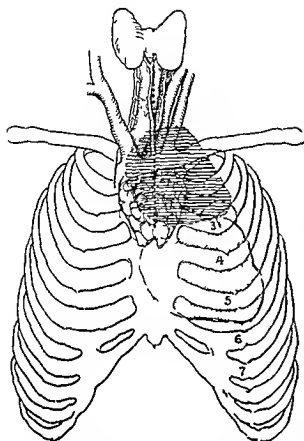


Fig 9 (Case) Sketch illustrating the position of the tumor. It was ovoid and extended from the thyroid gland downward into the chest.

capable of the same kind of differentiation. This is purely hypothetical, however, although the neurogenic sarcomata are resistant to X-ray therapy and in this they simulate other nerve tumors.

The tumor which arises from the capsule of the ganglion cells has not to our knowledge been described. Sachs mentions 1 case of tumors of the gasserian ganglion which he divides into two classes: (1) tumors which arise from the ganglion cells and (2) tumors which arise from structures of the dura lying adjacent to the ganglion. In some of the tumors of his series the origin was very indefinite. On a histological basis, however, such a tumor is possible and probably has occurred.

DIFFERENTIAL DIAGNOSIS

Among the cases summarized in Table I there was a history of symptoms or of the presence of a tumor mass for a longer period of

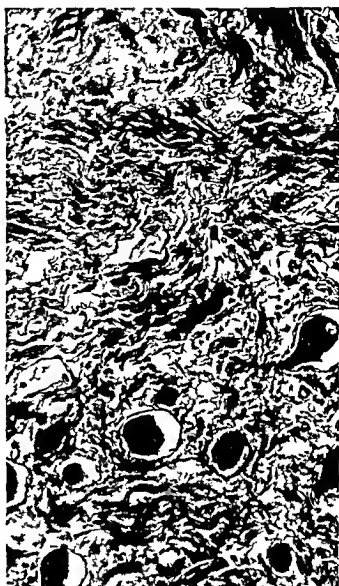


Fig 10 (Case) Photomicrograph ($\times 30$) of ganglion neuroma.

time than is usually associated with neoplastic growths in the neck or mediastinum, the longest duration—10 years—being reported in Case 17.

Pain is not a constant symptom, but when a tumor mass is freely movable and at the same time painful, close association with a nerve cord or plexus is suggested.

A substernal or intrathoracic goiter, more frequently than any other lesion, presents a clinical picture similar to that presented by a tumor of the type under discussion. In the presence of hyperthyroidism, of course, the mediastinal tumors are often mistakenly interpreted as adenomata of the thyroid gland.

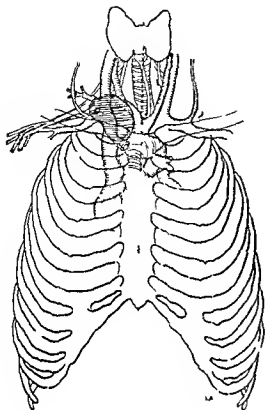


Fig. 1. (C) Section of the thoracic cage and upper abdominal region, showing the location of the thyroid gland and associated structures.

A few objective signs might offer some aid in diagnosis. Unilateral sympathetic nerve disturbance is an extremely rare symptom of

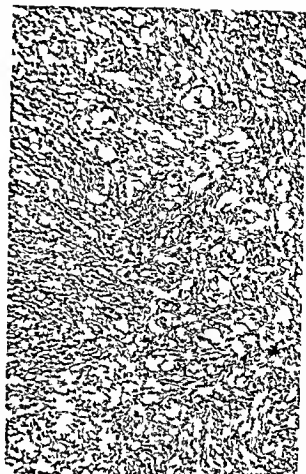


Fig. 2. (C) Section of the thoracic cage and upper abdominal region, showing the location of the thyroid gland and associated structures.

substernal goiter but it is a not infrequent characteristic of a mediastinal nerve tumor (Abbe). The thoracic cage may be elevated or distended and superficial veins may be present in the case of a tumor of either type.

The roentgenogram offers possibilities of differential diagnosis but is not a means of certain differentiation. The majority of adenomata of the thyroid are situated anterior to the trachea while a nerve tumor which arises from the prevertebral ganglia will necessarily be situated posterior to the trachea (Fig. 14). However adenomata not infrequently encircle the trachea and the largest portion of the growth may lie posterior to it. The trachea is displaced laterally in every case of nerve tumor (Figs. 4 and 8) because the ganglia lie at one side of it. The



Fig. 3. (C) Section of the thoracic cage and upper abdominal region, showing the location of the thyroid gland and associated structures.



Fig 14 (Case 3) Photomicrograph ($\times 260$) of ganglio neuroma Specimen taken from central portion

shadows are of uniform density and are ovoid in contrast to the shape of a thymus gland tumor which conforms to that of the thymus

Gibberd says that nerve tumors which are peripherally situated are of long duration and later are characterized by an increasingly severe neuralgic type of pain These tumors have often been mistaken for enlarged lymph glands

A clinical diagnosis of a mediastinal nerve tumor cannot be made with any degree of certainty In the absence of hyperthyroidism a history of long duration and the presence of a dense ovoid shadow posterior to the trachea are suggestive signs particularly if there is a unilateral sympathetic nerve disturbance



Fig 15 (Case 3) Photomicrograph ($\times 110$) of sympathicoblastoma Section taken from cortical area

At operation the diagnosis can be fairly definitely made as it is easy to rule out the thyroid as well as numerous other structures The large number of nerve fibers extending from the tumor is almost pathognomonic of this type of tumor The larger blood vessels are found to lie anterior to the tumor If there is any doubt a frozen section can be made and the diagnosis readily determined The morphology of the ganglioneuromata is so characteristic that a frozen section stained with methylene blue is perfectly reliable

TREATMENT

Surgical removal is the only treatment for this type of tumor for radium and the X ray do not stop its further growth Since the tumors tend to increase in size and those of an undifferentiated type tend to metastasize, it is imperative that such a growth be removed early when it is situated in the neck or

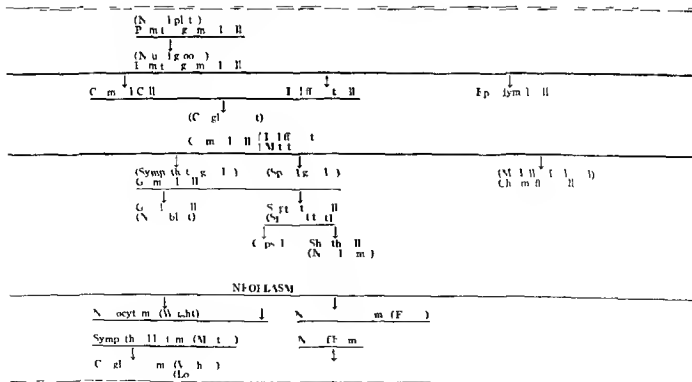
TABLE I.—SUMMARY OF REPORTED CASES OF TUMORS IN CERVICAL AND THORACIC SEGMENT

| N | A | L | D | D | R |
|-----------|-------|-------------------|-----------------|-----------------------|-----------------|
| 1 | h f d | Lo | d y m m | p l m | R m k |
| 1 | | F S m d l m l | P m l l l | Th f b m m Th | T m b l l m |
| | | l b l l l | m b l l | b f m h l | p l b l m |
| | | | | l m d l l d d | l c a f h |
| | | | | O l l l | h p l |
| 1 | | B f h l l l l | | m d l l d h l C | T h l l l |
| | | | | | f m m y h m |
| ALL 8 | | R h l l f k b h d | | A h l m l m | |
| | | | | pl l m d m k f l h d | |
| B h d | M | S l h l l l l m l | P l l l k f l | T m m F l f m l s by | C m l h l y |
| | | f k | m h | fb l m l | b b m i c p l g |
| | | | | | l d m |
| B l | h d | T p h l l k | | A l m N m l l d | B l l f m h |
| | | | | fb | l |
| T k | M | L f d l k | | | B l d l f m |
| | | | | | mp h |
| W l | M | C l h h | | T m l h m s m A | |
| | | | | m d l l d | |
| F l h | F | A l l l l m h | | A l m h s m | |
| | | h l l b | | l d l l h l l | |
| F i | M | R h l l l k h | l l h d f k l | A l l b l d b m m | Th l l l l |
| | | l h h | l y | p l h f | pl l f h h |
| | | | | l y l u s o m | l l h m |
| | | | | l l b l h p l m | |
| | | | | m l l l d f b m d l l | |
| M | M | R h l l l k l | l l h d l l f d | A l b l l d d l m m | P l l l h l |
| | | h h b l | D l h l l | Th l m d l h l | m f l l l m |
| | | h b h | | l | l l l m |
| C m l l | M | L l m d p o c | E l m l k h h a | W l l l l m l | G m h l |
| | | | h h l l m h l l | m f b | |
| S e m f l | l | N k b e h m l l l | E l m f k l m h | A l m h h d l | T m b l l m |
| | | l l l p f l | l d l m | l m l l l b e | h m l y |
| A l s o k | F | B h h l s e l d | | A l m m l b | |
| | | h h d | | s m N | |
| | | h h b | | m l l f m d l l | |
| | | | | l l R o s e l m | |

TABLE I—Continued

| N | A th d f t | Ag | Sex | Loc at | D t l ympt ms | D sc t f t m | R m k |
|---|----------------------------|----|-----|--|--|--|------------------------------------|
| 4 | R 9 3 | 8 | I | Right i f p t l
post m d t m | C gh los f w ght m t g
l g l l f t t f
ght d l th d m h l
b th g so d l e h l
b th g th l e h l
l m t | F m th u z f t h d l l
b l m l l t t h d m
p t t G ngl ell | H e y m t m
m p l d l p l |
| 5 | (C bl l
C I)
9 4 | 37 | M | L ft l f k b th
l m t d m scl
b h l b f t
t l t y | A h g p l l t d f k
l s m th p l p l l
t m bl ly l m l
t d | A gl t m j m l m t
m p l f l t m
th t g gl l l t m | F l l h th l m t
t g l t h l ft |
| 6 | (C bl d
C II)
9 4 | 3 | M | L ft l f k b th
l m t d m -ct | Sm l l t m m m l l y
l t l d t T y
d t | A l t f m t m u z f
p t N g gl ell | N t y m p t l t l g
p t f l l g |
| 7 | C l
B II
(C 9 8 I) | 8 | I | p m l t d post
j l l m d ght | T m m ght t f k
y h t l p t th d
t f t l b h t | A l t l t t f m s l t l
l l l t m h l
ss gm l m g s by
l m t bl | A t p y l t l
(S p t) |
| 8 | C l
B II
(C 9 8 II) | 8 | I | S p j g d t l m | T m m bo t y p m d
l b th g l p t th h y
l th g l 6 m th d l l | A gl bo f t m o t h
l m m t p l g t t
g gl l l p t l l | S p t |
| 9 | C l
B II
(C 9 8 III) | 4 | I | Right i f k p ve t
g p p t l
fo | T m m p t l p t s
y M g t m t d
p t d t l ght m | A gl l l t l soft
t m m t g s by 4 m m
C m p o s t f g gl l l
d f f t t t t l l
th t t f m t | S p t |

TABLE II—DIFFERENTIATION AND POSSIBLE SOURCE OF TUMOR CELLS



THE IMPORTANCE OF THE VESSELS IN THE ROUND LIGAMENT TO THE HEAD OF THE FEMUR DURING THE PERIOD OF GROWTH, AND THEIR POSSIBLE RELATIONSHIP TO PERTHES' DISEASE¹

A. P. ZEMANSKY, JR., M.D. AND R. K. LIPPMANN, M.D. NEW YORK
From the Laboratory of the Children's Hospital, New York

THE theory that occlusion of the vessels coursing through the round ligament causes the femoral head changes that characterize Perthes' disease is not a new one. It was first suggested by Schwartz, a pupil of Perthes in 1914, four years after the original description of the disease and it was based upon exhaustive clinical and roentgenological examinations. At that time however very few pathological specimens of the disease had been available for study and as a consequence there was considerable diversity of opinion regarding the findings that constitute the essential criteria of the disease. It was probably because of this inadequate background that Schwartz's idea received only scant attention.

Since 1914 the study of considerable additional pathological material has served to clarify in great measure our conception of the disease picture. It is now generally accepted that the microscopic criteria of Perthes' disease consist essentially of massive subchondral bone and marrow necrosis with marrow replacement by vascular granulation tissue. That these changes resemble closely those of healing infarction has been noted by Arxhausen, Bergmann, Nussbaum, Zemansky and others and this fact has lent support to the vascular occlusion theory.

Aside from the many clinical and pathological aspects of the problem it is apparent that the plausibility of Schwartz's theory depends directly upon whether normally the round ligament vessels are of importance to the nutrition of the adolescent femoral head. The importance of these vessels in this regard has been much questioned and constitutes the subject of this paper.

As Kolodny has demonstrated the adolescent femoral head is supplied with blood vessels of three categories: (1) blood vessels coming from the diaphysis of the femur (2)

epiphyseal blood vessels and (3) blood vessels carried by the ligamentum teres femoris.

The vessels of group 1 representing the end branches of the superior nutrient artery perforate the epiphyseal plate and enter the femoral head. Inasmuch as these vessels are only occasionally observed it is generally granted that their importance to the femoral head is insignificant.

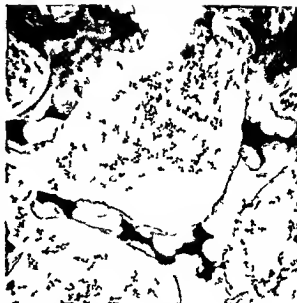
The vessels of group 2 enter the head along the edge of the articular surface. They are certainly the main source of nutrition to the periphery of the nucleus. As we hope to show later they are not of equal importance to the center and crest of the structure.

This central region and crest is directly entered by the round ligament vessels (group 3) after they penetrate the cartilage at the fovea capitis.

It is generally believed that the nutrition from this group is not of much significance to the femoral head and that if for some reason the circulation through them is impaired adequate collateral circulation from the epiphyseal branches will replace it. The literature however reveals that the importance of these vessels has been a matter of controversy since their original description by Paletta in 1800.

Paletta described a small artery, a branch of the obturator artery which perforates at the site of the incisura acetabuli and then splits into two branches—one for the acetabular fossa and one for the round ligament. The latter branch courses through the round ligament to supply blood to the femoral head.

In 1844 Sappey wrote that the function of the round ligament was purely that of protection for this artery. Two years later however Hyrtl announced that this was incorrect and that he had shown by injections that the vessel failed to enter the spongy bone that it anastomosed through capillaries with the venous system without entering the femur.



f m f l l t k l d j t d th b th
l th t pply th t t l l Ph
l l l l p l p m t t h B l l l
k pl t l f f th l l pp f m f abbt
k k l d l p d th t f f A Th
f m l f th p l l y th d l t
l l d t l a d d f by th p p h l
l l f l c Ph t ph t l h d f th
l l p l f k l d bl t th
j t d l Ph d k m t l a
l k f l l p l l a l m t l j l k f l



Iu chki mention that he never failed to observe branches entering the bony femoral head and Henk wrote that the function of the round ligament was nutritive but he expressed doubt as to whether the vessels communicate with those of the femur

Fanger studied the vessels carefully and in his paper Ueber die Gefassverteilung der Hohenknochen concluded as follows: In children there is a constant branch of the

h h h h m h l l f h f h h m l l

B

I A S t f th f m l h d n l m d
f m abl t o d y afl p l t th x m
th d m hed n m b f t bl t d th b g g
b l c h n g n the m ow c l l B Opp t
m l f m p n th p d l l t l

obturator artery which proceeds along the round ligament and enters the still cartilaginous head where it branches to meet the vessels entering about the joint periphery. Anastomosis occurs when calcification begins. Also in adults I have been successful

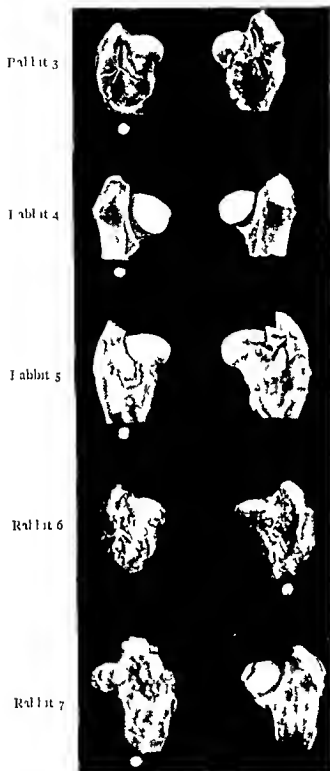


FIG. 3. The upper femora of rabbits three, four, five, six, and seven showing progressive bony deformation (Dot marks the femur of the side operated upon)

in identifying the artery that courses through the ligament. Langer believed that the vessels were of great importance but only until the establishment of the bony nucleus



FIG. 4. Rabbit killed 90 days after operation. Note the necrosis of the anterior portion of the bony nucleus and in the most anterior part the new growth of fibrous tissue

Moser's paper *Ueber das Ligamentum Teres des Hufstgelenks* is probably the most significant contribution to the subject. Moser made serial sections of femoral heads in all stages of fetal life and in children up to four years of age for the purpose of studying the blood supply. He discovered that in 12 centimeter embryos the vessels from the round ligament can first be identified in the cartilage. They can be seen to persist there until at least the fourth year of life. At this point because of technical difficulties Moser was unable to continue his studies. In contrast to Langer Moser was not convinced that the function of these vessels ceased when the bony nucleus became established. He wrote: "Later most of these vessels unquestionably atrophy." In adults I have found vessel openings in the fossa capitis only in half the specimens and whether these openings still contain active blood vessels is doubtful in that the canals may persist for a while after obliteration of the vessels. We may conclude that in adults the blood supply through the round ligament can be entirely dispensed with.

More modern methods of anatomical study such as injection with opaque solutions followed by roentgenography (Lexer) or clearing,



Il k b t f (d v ft p t) h
m ft dl

(Spaltcholz) have in the hand of many observers substantiated Moore's conclusions regarding the course and duration of patency of the vessels. Nevertheless, as late as 1907 Fick wrote that a large blood vessel had



I 6 R b l t t (d v ft p t) h
h ml t th b li th p d r b b t

never been seen in the round ligament and that the importance of this blood supply was unquestionably negligible.



I R b b t t (d v ft p t) h
p ed m f t l bo th k es f th
f t l ke d t u l f m a ty th d l



I 8 R b l t t (36 d v ft p t) h
I d t t th p ly l d h th
l lap f th l

In the most recent anatomical study of the femoral head circulation that of Kolodny in 1925 it was concluded. The blood vessels brought to the head of the femur in the ligamentum teres femoris play a certain role in the nutrition of the femoral head in newborn and child but are of no perceptible importance in the nutrition of the femoral head of the adult.

Thus anatomical studies have definitely established that in the adolescent the femoral head is nourished by the round ligament vessels. The importance to the femur of this nutritional source however remains undetermined.

One effort to ascertain whether in animals section of the round ligament and the consequent obliteration of the vessels coursing through it causes noticeable changes in the femoral head was found in the literature. Iselin in 1918 sectioned the round ligament of the hip joint in a series of dogs. The hips of the animals were X-rayed at periodical intervals thereafter. Iselin could discern no X-ray changes and concluded that the round ligament vessels were unimportant to the femoral head. Unfortunately the report of these experiments fails to mention the age of the dogs that were operated upon and it is thus impossible to evaluate his work correctly.

Some insight into the fact that these vessels are not entirely of negligible importance may however be gathered from the experiment of Bergmann in 1917. In one young rabbit Bergmann sectioned the epiphyseal blood supply to the head by cutting through the covering of the femoral neck for three quarters of its circumference. In another animal the same operation was performed but in addition the round ligament was cut. On examination the first specimen showed widespread necrosis of the head but less necrosis than was present in the specimen from the second rabbit. In other words necrosis of the head was more extensive following section of the round ligament than when it was left intact. Bergmann did not attempt section of the ligament alone.

From this brief summary of the literature concerning the round ligament vessels it is

apparent that considerable diversity of opinion exists regarding their importance to the femur. In the hope of obtaining a clearer conception of their function in this regard especially during adolescence the following experiments were undertaken.

A preliminary series of dissections in rabbits showed that the developmental stage of the capital epiphysis in animals 7 weeks old corresponds approximately to that of children 4 years old. These dissections further demonstrated that in these animals the femoral head unites with the shaft at about the age of 7 weeks (18 years in the human). With regard to this epiphysis then the span of life between the ages of 4 and 7 weeks in these animals corresponds roughly to that between 4 and 18 years in the human being the age period during which Perthes' disease occurs.

A subsequent series of arterial injections according to the method of Gross has demonstrated that in rabbits of these ages the vascular arrangement is not dissimilar to that of the human femur at a corresponding age. In Figure 1A a photograph of a typical 2 weeks old specimen a comparatively large artery can be seen which after coursing through the round ligament, penetrates the cartilage to supply the central area and crest of the nucleus while the periphery and base are cared for directly by the epiphyseal vessels.

Figure 1B the femoral head of a rabbit 5 weeks old shows well the diminution in size and importance of the round ligament vessels at this age. By far the greater part of the nuclear nutrition is at this age derived from the epiphyseal vessels.

Injectations of the arterial trunk in rabbits 7 weeks old and older (Figure 1C) demonstrate that the femoral head is nourished entirely by the epiphyseal arteries. The vessels that course through the round ligament at this age have ceased to enter the bony head and terminate before the ligament reaches the fovea capitis.

It may be concluded from this series of arterial injections that in rabbits the blood supply from these vessels to the femoral head gradually diminishes and ceases completely when the epiphysis unites with the shaft. It

cannot be stated with certainty that the round ligament vessels of the human cease to furnish blood to the femur at the same relative developmental stage. However inasmuch as all anatomical evidence indicates that these vessels usually are completely closed in human adult life it is most likely that a similar condition exists.

With these facts in mind we have sectioned the ligamentum teres on one side in a series of rabbits 2 weeks old thereby obliterating the circulation through it to the femoral head in order to determine the effect of this procedure on the developing capital nucleus.

PROCEDURE¹

After morphinization the animals were etherized and prepared for operation in the customary manner. A three quarter inch incision posterior and parallel to the greater trochanter was made and the fibers of the gluteus minimus muscle exposed. These were separated in the line of their course by blunt dissection and retracted together with the sciatic nerve which lies directly underneath. The small external rotator muscles were then sectioned and the underlying joint capsule incised along the border of the acetabulum.

By adduction and inward rotation of the thigh the point of attachment of the round ligament to the femoral head was presented to view and with a small sharply curved scissors the ligament was sectioned at this site. Closure was effected by means of silk muscle and skin sutures followed by a collodion dressing.

Eighteen rabbits 2 weeks old were so operated upon. Four of these rabbits died during or immediately after the operation and were consequently discarded. Four others were excluded because at autopsy it was found that the operative procedure had caused luxation of the hip. Two of the rabbits were excluded because of purulent infection at the operative site. In one rabbit the femoral head was injured during operation and the specimens from this animal were also

excluded from the series. Studies of the remaining seven rabbits constitute the following report.

The specimens from these animals were examined 6 9 18 27 and 36 days after operation.

CONTROLS

In order to ascertain whether or not round ligament section was responsible for the ensuing pathological changes the identical procedure was performed on the opposite hip of the experimental rabbits but the ligament after exposure was allowed to remain in the hip joint untraumatized and uncut. In none of these control specimens was there any gross or microscopic change detectable in the femoral head.

In order to establish that the changes were due to obliteration of the blood vessels rather than other complications of the operation three rabbits 7 weeks old were operated upon in a like manner. In rabbits of this age as our injections have demonstrated the round ligament vessels no longer enter the femoral head. Careful examination of the hip joints in these rabbits up to 5 weeks after operation failed to disclose any abnormality resulting from the operation.

It is thus safe to conclude that changes resulting from the operation are due to interruption of the circulation through these vessels.

EXPERIMENTAL RESULTS²

Rabbit one of this series was killed 6 days after the operation. No gross changes were demonstrable but microscopic sections of the femora obtained were instructive in illustrating the extent of the anemia resulting from the operation.

Section of the capital nucleus on the side operated upon shows that although blood cells can be seen in the region directly overlying the epiphyseal plate and in that portion closest to the trochanter the remaining marrow of the nucleus is almost completely anemic. The area in which red blood cells can be found only with the greatest difficulty is in striking contrast to the corresponding region in the section of the opposite femur. This area is well filled with blood as are all other bony areas apparent in the sections. Figure 2A taken from the capital nucleus on the normal side shows the usual number of blood cells filling the capillaries. Figure 2B illus-

The femoral head of the rabbit operated upon 6 days after the operation. The section shows the capital nucleus on the side operated upon. The area in which red blood cells can be found only with the greatest difficulty is in striking contrast to the corresponding region in the section of the opposite femur. This area is well filled with blood as are all other bony areas apparent in the sections. Figure 2A taken from the capital nucleus on the normal side shows the usual number of blood cells filling the capillaries. Figure 2B illus-

In the femoral head of the rabbit operated upon 6 days after the operation. The section shows the capital nucleus on the side operated upon. The area in which red blood cells can be found only with the greatest difficulty is in striking contrast to the corresponding region in the section of the opposite femur. This area is well filled with blood as are all other bony areas apparent in the sections. Figure 2A taken from the capital nucleus on the normal side shows the usual number of blood cells filling the capillaries. Figure 2B illus-

trates the sparsity of these cells in the affected area. It is apparent from Figure 1A that the anæmic area corresponds well with the region that at this age is directly nourished by the round ligament vessels.

Aside from the anæmia of the side operated upon there is perhaps a slight diminution in the number of osteoblasts bordering the bony lamellæ. On examination with the high power several nuclei of the marrow reticular cells and those of the blood forming cells show evidence of necrobiosis namely pyknotosis karyotexis karyolysis otherwise no changes were noted.

Rabbit two also killed 6 days after the operation showed changes so similar to those of rabbit one that they do not warrant a separate report.

Rabbit three killed 9 days after operation showed a slight flattening of the femoral head on the side operated upon. In Figure 3 this deformation is apparent. On longitudinal section of the nucleus on this side the entire bony portion appeared pale and there was a small area of yellowish discoloration directly beneath the collapsed portion of the surface.

Microscopic examination disclosed that the surface and epiphyseal cartilages were well stained and intact. The bony lamellæ posteriorly contained approximately the normal number of well stained bone cells. The marrow of this region as well as the endosteum appeared also to be intact. In the central portion of the nucleus there were more empty bone lacunæ to be seen the osteoblasts were fewer in number and in the upper part a collection of debris was apparent which consisted of necrotic hæmogenic cells. The position of this necrosis corresponded to the area of yellowish discoloration seen on gross section. The anterior third of the nucleus (that closest to the round ligament) appeared completely necrotic. All of the bone lacunæ in this area were empty no osteoblasts could be found and the marrow tissues were very poorly stained. In the most anterior portion there could be seen a small area of beginning fibrosis. Figure 4 illustrates this finding.

Rabbit four died on the twelfth day after operation of inanition. The femoral head on the side operated upon was flattened as in the preceding specimen and this deformation was more marked. In addition to the flattening the head had assumed a mushroomed contour suggesting that of true Perthes disease (Fig. 3).

On gross section the changed contour of the nucleus was still more apparent. There was considerable diminution in its height as well as increase in its lateral diameter. The entire nucleus was paler than that of the opposite side and the region underlying the crest was yellowish in color as in the preceding rabbit.

Microscopic section showed as before the surrounding cartilage to be well stained and containing normal looking cells. The area of nuclear necrosis which in the preceding specimen was confined to about one third of the total area occupied here over half the structure. The bony lamellæ of the anterior

and upper portion contained many empty bone lacunæ although posteriorly and directly above the epiphyseal line the bone cells were well stained. Osteoblasts in the affected area were present but the number of them was definitely diminished. The marrow in this area was anæmic and completely fibrotic. Centrally there could be seen a large area of hæmogenic cell debris corresponding to the yellow area that was apparent on gross section (Fig. 5).

Rabbit five killed 18 days after the operation showed grossly still more flattening than the preceding specimen although its general shape was less mushroomed and more in conformity with the normal. The surface cartilage was ridged anteriorly with a shallow groove which can be seen well in the illustration (Fig. 3).

On gross section of the specimen the entire nucleus was paler than that of the opposite side and as before the area underlying the crest was of a yellowish color. The bony nucleus was decidedly smaller in size than that of the opposite side and the layer of cartilage surrounding it was considerably thicker.

Microscopically although the specimen was very similar to that of rabbit four the area of marrow debris was larger and anteriorly the endosteal cells were still fewer in number and a larger relative number of bone lacunæ were empty. The posterior and lower portions of the specimen were intact. The surface and epiphyseal cartilages appeared thickened but otherwise normal.

Rabbit six died on the twenty seventh day after operation of inanition. Autopsy disclosed that the femoral head on the operated side was considerably smaller than that of the opposite member. It was slightly bluish in color and marked with a deep transverse furrow. A mild degree of coxa vara was present and can be seen in the illustration (Fig. 3).

On gross section the bony nucleus was approximately one half the size of the opposite control though the layer of surrounding cartilage was thicker. The entire nucleus was grayish yellow in color.

Microscopically the cartilage was normally stained but considerably thickened. The marrow cavity throughout the section was filled with a mass of debris consisting largely of necrotic and poorly staining round cells. The reticulum and endosteum could be identified only in a few small places lying directly above the epiphyseal plate. The bony lamellæ which in the opposite normal consisted almost entirely of calcified bone were in this section largely cartilaginous. In the anterior and upper sections practically no true bone was seen and normal lamellæ could be found only at the base and posterior portions of the section. The bone cells themselves were perhaps better preserved than in the preceding sections though the greater part of the lacunæ were either empty or contained pyknotic cells (Fig. 7).

Rabbit seven died on the thirty fifth day of inanition. Autopsy showed the femoral head on the side

crater lupin to be about one half the size of the normal. The head was markedly flattened and there were two deep transverse furrows. In the region of the fovea capitis the surface cartilage was pitted in several places (Fig. 3).

Cross section showed as before the bony nucleus to be about half the size of that of the opposite member and surrounded with a much thicker cartilaginous shell. It was of yellowish color and of hazy consistency.

Microscopically the cartilage was normal in staining qualities but some had thickened. The marrow of the posterior part of the upper femur contained a large mass of cellular debris. Even the reticulum was unstained in these areas. Anteriorly the fibrous stroma appeared well stained.

Endothelial cell elements were completely lacking in this area. Throughout the specimen many small hemorrhagic clusters of red cells occurred. None were seen in the marrow capillaries which as in the previous specimens were empty. Osteoblasts were completely absent from the specimens except along the margins of the loosest bone lamellae where many of them could be seen. The bony lacunae were almost entirely empty with the exception of a few small areas in which cell stained bone cells occurred. These areas were in the lower and posterior parts of the section. Figure 8 shows in addition the indentation of the fovea capitis which rests close to the epiphyseal plate.

SUMMARY

The femoral head changes thus observed following round ligament section in rabbits six weeks old may be classified as follows:

1. *Anæmia* Anæmia of the anterior portion and crest of the nucleus was observed first in the femoral heads of the two rabbits killed on the sixth day. Anæmia of this area characterized all of the subsequent specimens observed.

Signs of bone necrosis Pyknosis and failure of the bone cells to stain in the anæmia area was first observed in the 9 day specimen. The number of the bone cells thus affected increased in the later specimens until we find in the specimen taken 22 days after operation that practically the entire anæmic area contains only empty cell lacunae.

2. *Marrow necrosis* Necrobiosis was observed to occur in the marrow cells of the specimens taken after 6 days. Failure of the haemogenic elements to stain and incipient marrow fibrosis were first apparent in the 9 day specimen. Necrosis of the marrow stroma was first observed in the 11 day specimen.

3. *Signs of cessation of ossification in this area* Grossly the relatively smaller size of the bony nucleus was first apparent in the 18 day specimen. The thickening of the surrounding cartilage and the increased proportion of unossified cartilage in the bony lamellae of the nucleus could be seen macroscopically in the same specimen and in all those subsequently observed. The diminution in number of the osteoblasts was first apparent in the 9 day specimen. In the last three specimens no osteoblasts were identifiable in the affected area.

4. *Gross deformation of the femoral head* Flattening of the weight bearing area and ridging occurred first in the 9 day specimen. The later specimens show in addition pitting and suturing of the surface. Microscopically the cartilage of this area is well stained and intact.

5. *Cystic area* First apparent in the 18 day specimen and present in all the subsequent ones.

The fact that the changes mentioned were in all the specimens associated with anæmia and the resemblance of these changes to those of infarction suggest strongly that they are due to the circulatory interference of the operation. When it is considered that the affected area is at this age period directly supplied by the vessels of the ligamentum teres (as our injections have shown) and that the changes fail to appear when the operation is performed after the vessels have closed there can remain little doubt that the pathological picture results from obliteration of the round ligament circulation alone.

The patchy hemorrhagic areas that were observed in the specimen of rabbit six as well as the round cell marrow infiltration seen in rabbit seven cannot be regarded as characteristic findings in that they were each observed in one specimen only. Moreover similar changes to these are not infrequently found in areas of infarction in other regions of the body and indeed they have been described as occurring in true cases of Perthes' disease (Riedel-Walter).

The access of migratory cells to the area of infarction may be explained by the fact that while the round ligament arteries are func-

tionally end vessels capillary anastomoses between them and the peripheral epiphyseal branches do exist. While apparently these anastomoses are adequate to carry blood cells to the infarcted tissues the above experiments have shown that they are insufficient to preserve the viability of the affected area.

CONCLUSIONS

It may thus be concluded from these experiments that the vessels of the round ligament are essential at least in rabbits for the normal development of the femoral head and that interference to the circulation through them at an early age produces an anemia of the weight bearing portion of the capital nucleus which in turn causes bone and marrow necrosis with ensuing secondary deforming changes.

Furthermore our studies have demonstrated that as adolescence progresses the importance of these vessels gradually diminishes until the epiphysis unites with the shaft at which time in normal animals the vessels no longer carry blood into the femur and the nutrition of the crest is derived entirely from below.

It is reasonable to suppose that a similar replacement occurs in the human at the same relative age period as the period during which Perthes' disease appears. If this supposition is correct it is not unlikely that the immediate cause of the disease lies in some maladjustment of the delicate physiological balance that must exist between these sources of nutrition to the crest of the femoral head.

Whether the changes produced in the femora of our experimental rabbits are analogous to those of early Perthes' disease cannot at the present writing be established with certainty. However the similarity of the experimental specimens to those of real Perthes' disease that have been observed is striking. While the experimental specimens

have not shown the vascular granulation tissue that characterized most of the studied examples of the true disease it should not be forgotten that this granulation tissue may well be a healing phenomenon and therefore late in appearing. Whether this tissue will occur in the femoral heads of rabbits permitted to live a post operative course longer than 35 days remains to be determined by a continuation of this series of experiments.

We wish to express our gratitude to Dr. Louis Gros, director of the Pathological Laboratory, Mount Sinai Hospital, and Dr. Paul Klemperer, pathologist to the hospital, for their careful revision of this work.

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CHANGES IN THE INTESTINAL FLORA AFTER GASTRO-ENTEROSTOMY AND PARTIAL GASTRECTOMY

BERNARD PORTIS M.D. PH.D. CHICAGO

J. Th. N. M. I. t. f. M. d. R. h. d. S. g. o. l. D. p. m. t. f. h. M. h. R. H. p. I.

GASTRIC surgery has made many advances during the recent years with a tendency to more extensive stomach resections for gastric and duodenal ulcers. However the majority of surgeons still prefer the less radical procedures of gastro enterostomy and pyloroplasty for peptic ulcer and more especially for the duodenal variety. A solution of the problem involved in this article was sought after a study of the results obtained by S. A. and B. Portis in their work described in their article entitled "Effects of Subtotal Gastrectomy on Gastric Secretion" (10). In this article it was shown that the stomach remaining after subtotal gastrectomy still continued to secrete free hydrochloric acid which could be demonstrated in a Pawlow pouch contiguous with the main body of the stomach. However the gastric contents from the stomach itself showed in achlorhydria. In the present study we have endeavored to learn the possible effects on the upper intestinal flora of an absence of free gastric acidity.

LITERATURE REVIEW

Various methods have been used in clinical and experimental studies of the bacterial flora of the intestinal tract. The method described by Arnold was the one found most suitable in this study and will be discussed under technique.

The relationship of the acidity of the stomach and duodenal flora has been considered by numerous men with especial reference to various diseases of the body and alimentary tract especially with reference to pernicious anemia. In a very careful study of the relationship of the hydrogen ion concentration and the bacterial flora Arnold and Brody (2) conclude that when the normal reaction of the contents of the duodenum and upper jejunum is changed from slightly acid (Ph 5.1 to 6) to a neutral reaction (7-8) there is a moderate change in the bacterial flora in this part of the intestinal tract but when they

become alkaline the resultant flora resemble that of the lower ileum and the colon. Furthermore the maintenance of a normal hydrogen ion concentration was dependent to a great extent on the normal gastric secretory function. In a study of 100 cases of gall bladder disease in which cultures were taken of the duodenal contents and correlated with its acidity Heddy found the flora richer with decreasing acidity of the duodenum. Bitter and Lohr in examining the bacterial flora of the stomach and upper small intestine in 190 patients after various gastric operations found that gastric acidity is of great importance in the control of the bacterial growth in these regions and coincident with a decrease in the acidity the large intestinal flora gradually encroaches on the small intestine and in achylia these fecal bacteria may even reach the stomach. Rices Sears and Downing made similar observations in 30 cases of achlorhydria in which the duodenal content was rich in bacteria many of which had blood destroying properties. Nye Zerfos and Cornwell also showed a higher percentage of yeast like fungi in gastric contents in the same conditions.

Goldman showed that the bacteria introduced with food and saliva multiply only temporarily on the inside of the undigested food masses. Arnold and Brody (3) described the auto disinfecting mechanism of the upper intestine as dependent upon the presence of acid buffered material. This reaction is insured in the normal healthy animal by normal gastric secretory function. However when neutral or alkaline buffered material enters the duodenum the bactericidal power is lost. Prentiss concluded that hydrochloric acid exerts a strong inhibitory effect on the growth of ordinary bacteria which enter the gastro intestinal tract. The other enzymes and bile secretions do not seem to have any antiseptic power. Butler stated that after gastrectomy there is a loss of the

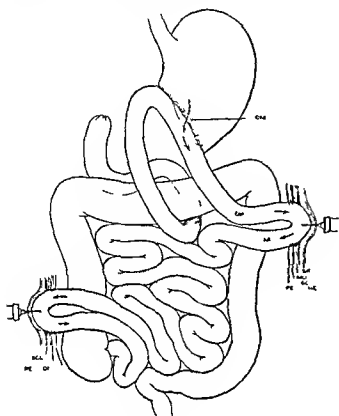


Fig. 1 Drawing of partial gastrectomy on dog. The method of fixation of the intestinal loops and the aspiration of the intestinal contents is shown.

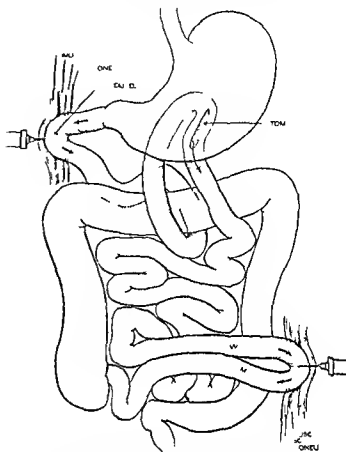


Fig. 2 Drawing showing gastro-enterostomy. The method of fixation of the intestinal loops and the aspiration of the intestinal contents is shown.

sterilization by the stomach and with the increase in the alkalinity the bacteria spread upward from the colon to the upper small intestine. In 22 cases of perforated gastric and duodenal ulcers Lohr was unable to find colon organisms in the peritoneal exudate in the first stages.

These and many similar reports demonstrate several features of the interrelationship of the upper intestinal flora and gastric secretion. The gastric acidity has apparently two fold action in the control of the intestinal flora of the upper small intestine. The bactericidal action on ingested food has been very conclusively proved and is of great importance. However the feature of the acidity of the duodenal contents and its influence on the intestinal flora has been considered by only few workers from an experimental standpoint.

EXPERIMENTAL PROCEDURES

Four of the animals are considered in this report as various experimental and laboratory factors preclude the use of the others operated

upon. Two dogs were experimented with at the same time one being subjected to a gastro-enterostomy and the other to a partial gastrectomy. In the first group the intestinal flora was studied from both the upper and lower small intestine while in the second group material was obtained from the jejunum only.

The intestinal loops were established after the method described by Arnold and his co-workers. In the first group having two loops two pararectal incisions were made down to the peritoneum. When the peritoneal cavity was opened the appropriate part of the small intestine was grasped in forceps and with drawn from the abdomen. About 5 centimeters was finally utilized for the loop. The peritoneum was sutured to the intestine along the mesenteric attachment so as not to interfere with the circulation or obstruct the lumen of the bowel. The deep fascia was then sutured near this peritoneal attachment and the skin closed over the loop a sub

TABLE I—RESULTS IN DOGS 1 AND 2

| INTESTINAL FLORA | | B f
pre | Af
p |
|------------------------------------|----|------------|----------|
| Dog 1—gastro enterostomy | | | |
| Colony unit (a e g e) jejunal loop | | 8 500 | 8 000 |
| per c cm | | | |
| Colony unit (a e g e) ileal loop— | | 59 500 | 12 000 |
| per c cm | | | |
| Dog 2—gastro enterostomy | | | |
| Colony count (a e g e) duodenal | | 8 500 | 39 000 |
| loop—per c cm | | | |
| Colony count (a e g e) ileal loop— | | 4 000 | 24 000 |
| per c cm | | | |
| GASTRIC ANALYSIS | | B f
fl | Af
fl |
| Dog 1—gastro enterostomy | | | |
| 1st g | 15 | 25 | 35 |
| 1st h u | 1 | 73 | 55 |
| Sec d h r | 5 | 95 | 8 |
| Dog 2—gastro enterostomy | | | |
| 1st g | 14 | 35 | 45 |
| 1st h u | 14 | 8 | 83 |
| Sec d h r | 4 | 8 | 85 |

cuticular stitch being used. Collodion dressing was then applied. In this way the portion of intestine for study was anchored beneath the skin and the contents were removed at any desired time by means of a large needle inserted through the skin into the bowel. In the dog which was to be subjected to a partial gastrectomy the two incisions were placed as follows:

The jejunum was brought through the upper left incision and the ileum through the lower right (Fig. 1). In the dog with the future gastro enterostomy the duodenal loop was withdrawn through the upper right incision and the ileum through the lower left (Fig. 2). In the second group of animals only one loop was prepared in which the upper jejunum was brought through a right pararectal incision. The animals were given water for the first 24 hours and then they were gradually returned to the previous diets. Each animal was kept on a standard diet for several weeks before it was used for experimental work.

The bacterial flora was analyzed as follows. The skin over the artificial hernia was shaved and iodized. A large bore hypodermic needle was plunged through the skin into the lumen of the bowel and the contents were withdrawn and put into sterile test tube. The loops were aspirated usually one hour

TABLE II—RESULTS IN DOGS 3 AND 4

| INTESTINAL FLORA | | B f
pre | Af
p |
|--------------------------------|----|------------|----------|
| Dog 3—gastro enterostomy | | | |
| Colony unit (a e g e) jejunal | | 500 | 900 |
| loop—per c cm | | | |
| Dog 4—gastro enterostomy | | | |
| Colony count (a e g e) jejunal | | | 1 600 |
| loop—per c cm | | | |
| GASTRIC ANALYSIS | | B f
fl | Af
fl |
| Dog 3—gastro enterostomy | | | |
| 1st g | 5 | 0 | |
| 1st h u | 6 | 5 | |
| Sec d h r | 5 | 9 | 0 |
| Dog 4—gastro enterostomy | | | |
| 1st g | 5 | 0 | 5 |
| 1st h u | 5 | 0 | 4 |
| Sec d h r | 15 | 0 | 75 |

after feeding. The intestinal material was then plated in varying dilutions up to 1:100,000 on blood agar plates and analyzed. Endo plates, broth cultures and fresh smears were made simultaneously. Colony counts were made after 48 hours incubation at a temperature of 37 degrees C. and the various bacteria were identified from the different media. These bacterial studies were made at weekly intervals.

After this stationary period had been reached and the animals were in good general health the second operative procedure was carried out. This consisted in performing a gastro enterostomy in one dog of each group and a partial gastrectomy in the other. The technique followed has been described by the author in a previous paper. The bacterial flora was studied after the animals had recovered from the operations. The results of the normal and postoperative periods are included in Tables I and II. The gastric content was analyzed during the stages of the experimental work and the results are also included in the tables.

DISCUSSION

The jejunal loop showed a marked increase in the colony count after subtotal gastrectomy (Table I) whereas no similar findings were noted after gastro enterostomy. Likewise the qualitative analysis of the former showed an entirely new flora with faecal organisms pre-

dominating. After a considerable period of time this had all the characteristics of the contents from the ileum loop. Changes were also seen in the ileum loop after the stomach operations, those being most marked after the subtotal gastrectomy. The gastric analyses demonstrated a condition of achlorhydria as has been previously noted by the author (10) after the partial removal of the stomach in contradistinction to no material alteration after the gastro-enterostomy. The results obtained in dogs 3 and 4 (Table II) in which only a jejunal loop was utilized were quite similar to those which were obtained in the previous animals.

The upper intestinal flora was definitely changed after partial gastrectomy. The explanation of this is probably dependent on several factors. The stomach after a subtotal gastrectomy still secretes free acid although in smaller amounts and food leaves the stomach in about half the normal time. These two facts in addition to the ease of influx of alkaline pancreatic juice, bile, and duodenal secretion into the stomach with its neutralization of the small amount of gastric secretion permits the bacteria laden food to pass into the small intestine with very little alteration. The bacterial growth is further enhanced by encountering a marked alkaline medium in the jejunum. Later the lower intestinal flora gradually spreads upward and finally the flora of the entire small intestine becomes practically homogeneous.

The intestinal flora after gastro-enterostomy did not show similar changes as here the bactericidal action of the stomach was still active and the acidity of the upper small intestine was only slightly reduced.

CONCLUSIONS

1. The upper intestinal flora of dogs is markedly changed after subtotal gastrectomy and gradually assumes the fecal character of the lower intestine.

Gastro-enterostomy does not materially alter the bacterial flora of the intestinal tract.

3. Alteration in intestinal flora after the partial removal of the stomach is probably due partly to the loss of the bactericidal activity of the stomach through the establishment of an achlorhydria partly to the more rapid emptying time of the stomach and finally the alkaline medium of the jejunum greatly predisposes to the further multiplication of its bacterial content.

4. A clinical deduction may be drawn in that although partial gastrectomy seems to be the best operation in certain cases of ulceration of the stomach and the duodenum, a new factor is introduced with the fecal change of the upper intestinal flora. The results of this alteration in the general body physiology will take many years to establish.

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ABERRANT BLOOD VESSELS AS A FACTOR IN LOWER URETERAL OBSTRUCTION

PRELIMINARY REPORT

JOSEPH A. HYAMS, M.D., F.A.C.S., NEW YORK

F m h D j m f l l g y N y k P G d M d l s h o o l d H r i

OBSTRUCTION of the lower ureter by aberrant vessels or bands of fibrous tissue has evidently been deemed not sufficiently important to warrant special consideration by the surgeon as evidenced by the manifest paucity of literature on the subject. In monographs and articles considering stricture of the lower ureter many causative factors are assigned for this condition among which infections from either local or peripheral foci, traumatism, syphilis, cystitis, cystica, etc., may be mentioned. Adventitious bands and vessels as etiological factors apparently have not been given consideration.

The following study has as its basis the operative findings in a case of ureteral calculus obstructed by an aberrant artery and band of fibrous tissue at the midpelvic portion of the ureter. The autopsy findings in a case with similar obstructive pathology in a male cadaver together with observations made during a series of dissections to determine the relation between aberrant vessels and the ureter and between parietal vessels of the pelvis and the bladder.

On August 5, 1933, M. H., a male 44 years of age, admitted to the service of Doctors McCarthy and Bandler at the Post Graduate Hospital, came under my care. He complained of pain in both loins and peristent vomiting. For 3 years prior to admission this patient suffered with intermittent pain over the sacroiliac and kidney regions at intervals of 5 to 6 months. The pain was colic-like, lasted 6 to 8 hours, and was more severe in the region of the left kidney. He voided twice at night but there was no diurnal frequency. Both his past and family history bore no relation to his present condition.

The patient, as a man of average height and weight, somewhat anemic in appearance, his physical examination suggested the presence of impending uremia. Examination of his head, neck, and chest showed no abnormality. The heart was found to be surgically competent though the sounds were diminished in volume. The kidneys were not palpable. The

liver was very much enlarged. There was marked tenderness on deep palpation in the right and left ureteral regions. The external genitalia were normal on inspection and palpation. The prostate on bimanual rectal examination was normal in size and contour with no fixation or areas of hardness or induration. Seminal vesicles were not palpable. The pulse showed slight increase in rapidity. Temperature and respirations were normal.

The urine was alkaline in reaction with a small amount of protein present. An occasional hyaline cast as well as a few red and white blood cells were found in the high power field.

The blood picture showed erythrocytes 4,746,000, leucocytes 3,600 with a hemoglobin of 81 per cent, differential count of 100 white cells: polymorphonuclear neutrophils 84 per cent, small lymphocytes 8 per cent, large lymphocytes 8 per cent, indicating moderate leucocytosis. Blood pressure and coagulation time were normal. Chemical examination of the blood made on August 7, 1933, was as follows: Uric acid 8.5 milligrams per 100 cubic centimeters; urea nitrogen 63.5 milligrams creatinine 3.5 milligrams; sugar 0.176 per cent per 100 cubic centimeters; chloides 0.475 per cent. Subsequent chemical blood examination made on September 4, 1933, 4 days before operation showed that no material change had taken place: the urea nitrogen being 6.9 milligrams per 100 cubic centimeters and creatinine 3.1 milligrams.

X-ray examination of the genito-urinary tract showed that the right kidney was of comparatively normal outline and dimensions; the left appeared to be considerably enlarged and lower than the right (Fig. 1). There was no evidence of calculus in the upper urinary tract but a roughly triangular shadow was apparent in the lower. One was in the lower central right bladder region (Fig. 2) and the other just above the left ischial spine, suggesting the presence of calculi in the ureters.

On August 27, 1933, cystoscopic examination showed the bladder to be of normal capacity with the presence of a moderate degree of cystitis. The left ureteral orifice as normal in appearance; the right was surrounded by a zone of edema, a factor indicating the presence of a calculus lodged at or immediately above the intramural portion of the ureter. An ureteral catheter could not be advanced up the right ureter more than a few centimeters. Indigo carmine renal function test showed no dye from the left side and only a small amount from the right side. Dilatation of the ureters was attempted



Fig. 1. Roentgenogram of kidney region showing calcified left kidney.

through the cystoscope and following the manipulation the patient had anuria for 24 hours which gradually subsided. The chemical examination of the blood showed the urea nitrogen and creatinine to be 61.9 milligrams per 100 cubic centimeters and 3.1 milligrams per 100 cubic centimeters respectively. An x-ray and cystoscopic examination on the same day (September 4) showed no advance of the calculi.

The persistence of pain in this patient's left ureteral and kidney regions with no apparent improvement in his general condition was deemed sufficient to warrant an operation to prevent permanent impairment of the kidneys.

On September 6, 12 days after admission, I performed a ureterotomy making a median suprapubic incision with an extraperitoneal approach in a manner similar to that employed in operations on the bladder for neoplasm or diverticulum. This incision was used instead of the usual oblique or vertical abdominal exposure in order to give easy access to both ureters through a single wound. The bladder was mobilized on its anterior aspect and freed on the right side down to the vesicopelvic fold. The ureter was identified and a calculus found lodged slightly distal to the intramural portion of the ureter. The wall of the ureter was incised longitudinally and through its outer intramural portion the calculus was removed. A single suture of catgut was inserted to close the ureteral incision loosely. Following this the bladder was freed in a similar manner on the left side and a moderate size calculus was palpated within the lower ureter at its midpelvic portion. The ureter was bound down by a transversely running band of fibrous tissue traversed by an artery approximately 6 to 8 centimeters above the ureteral orifice and was dilated above the band and the vessel. It was impossible to force the calculus through the constriction. The fibers were

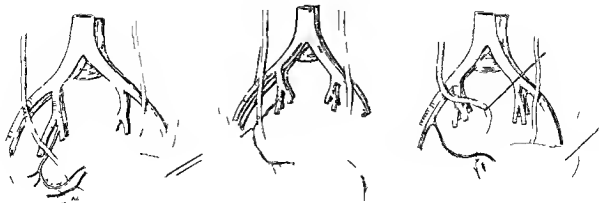


Fig. 2. Roentgenogram of lower ureteral and bladder region showing calculus shadow in right lower ureter which appears to be in the right lower bladder region, left calculus shadow seen at the midpelvic portion of the ureter.

teased away the vessel clamped in two places cut and ligated. The ureter now freed was incised longitudinally and the calculus was removed. The lumen of the lower portion of the ureter was dilated and the ureteral incision closed with a suture of plain catgut. The abdominal wound was closed in the usual manner, a prevesical drain inserted and a cigarette drain from each ureteral incision brought out at the lower angle of the wound. Recovery was uneventful; the prevesical drain was removed at the end of 7 days; the wound healed by first intention and the patient left the hospital 3 days after operation fully recovered.

The finding of an aberrant vessel with a reinforcing band compressing the ureter at this site 6 to 7 centimeters above the ureteral orifice and causing obstruction to the passage of a calculus was thought to be of sufficient interest to warrant further investigation.

Reference to the literature shows numerous articles on aberrant vessels of the kidney region and the upper ureter. These vessels



I 33

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have been considered not only from an anatomical standpoint but as possible important causative factors in obstructive ureteral and renal pathology. Our knowledge along these lines has been greatly augmented by the work of Pitt Rasteau Ekehorn as well as Mayo Ruppert Esendrath and others in this country. Writers differ as to the frequency of the occurrence of aberrant vessels at this site the average being 6 to 8 per cent some even going as far as Hellstroem who in a very complete article states that the renal arteries show so many variations with respect to number origin and distribution that it is almost more common to observe a condition that is abnormal in some respect than a condition that is normal in all respects. In our own series of over two hundred dissections of males 18 per cent showed definitely atypical renal vessels. In none of these however could obstruction to the ureter or kidney pelvis be demonstrated.

In renal surgery we anticipate the presence of aberrant vessel and if present clamp in two places before incising and ligating. The suggestion of Esendrath still holds good.

During nephrectomy or even nephrotomy the poles of the kidney should be carefully exposed. The mobilization of the kidney should be gradual care being taken at the lower and upper poles never to tear or divide adhesions or strands of fibrous tissue before they have been inspected and also palpated (for a possible pulsation) to exclude the possibility of a supernumerary vessel.

After ureterolysis no reference has been found to vessels as a cause of obstruction of the lower ureter. If the anatomy of the region is considered—a small space crowded with mobile structures which have an elaborate blood supply—it is fair to assume that anomalous vessels should be present in view of the fact that changes take place in these organs and vessels at and after birth and that aberrant vessel should frequently be found in the upper ureter and kidney regions.

The following is a brief description of the course of the vessels and the ureter in the pelvis as described in the standard anatomical works. The external and internal iliac arteries and their companion veins—branches of the common iliac—normally take their origin in the vicinity of the sacro iliac synchondrosis on a level with the lumbosacral articulation. The external iliac passing along

the brim of the pelvis to the lower border of Poupart's ligament where it becomes the femoral is not relevant to our present study. The internal iliac the hypogastric artery a short wide vessel approximately one and one half inches long descends into the pelvis minor and divides near the upper margin of the greater sacrosacral notch into an anterior or visceral and posterior or parietal group.

Sabotier¹ states that the internal iliac divides in a very inconstant manner. The anterior branch passes downward and forward and gives off the obturator which passes to the obturator foramen and the umbilical branch. The latter passes forward to the posterolateral aspect of the bladder is crossed by the ductus deferens and gives off the superior middle and inferior vesical arteries terminating in the obliterated hypogastric or lateral umbilical ligament. The inferior vesical artery is described in several anatomies as an independent branch from the anterior branch of the hypogastric artery. A branch to the vas (the deferential artery) may originate from any of the vesical arteries though it arises most frequently from the inferior or middle. Occasionally all the branches of the internal iliac artery arise without previous separation of that vessel into two portions (3.3 per cent).

The ureter in its downward course crosses anteriorly to the external iliac at or near its origin and passes downward and inward along the front of the hypogastric artery. It then turns mesially below the ductus deferens in the male toward the base of the bladder.

A series of dissections of male cadavers served to show that these vessels show wide variations both in course and distribution. Among the first dissections as illustrated in Figure 3 an aberrant artery and vein were found which crossed the ureter at right angles accompanying them was a band of fibers which traversed the ureter 7 centimeters above the ureteral opening being practically a replica of the condition found in the patient whose history is cited.



Fig. 3. Schematic drawing showing the vesical branch coming from the umbilical artery anterior to the ureter.

Another interesting anomaly (Fig. 4) was an atypical vessel a branch of the obturator artery which crossed the ureter to the anterior surface of the bladder without coming in contact with the ureter. Branches from the obturator artery to the bladder wall were found in four instances in our dissections up to the present time. While some of these are small as described in the textbooks in several instances a large branch of the obturator was found which crossed to the side of the bladder taking the place of the inferior vesical artery which was absent and giving off a branch which extended backward looped about the ureter and terminated as the deferential artery. An extreme type was observed in a recent dissection in which there was no umbilical artery on either side the vesical arteries—superior middle and inferior—being given off by the obturator artery of the corresponding side.

In another instance (Fig. 5) a vein from the external iliac looped itself about the lower ureter.

The hypogastric and its branch the umbilical artery vary greatly in length. The umbilical artery has been found to show marked variation both as to the site of its junction with the bladder wall and the extent to which it is in relation to it. At the crossing of the ureter and the vas the umbilical artery is found to be external to these structures. Depending on their point of origin from the umbilical artery the vesical branches are found to course either external or internal to the ureter. Similarly the site of origin from

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Fig 7. Illustration of the relationship between the umbilical artery and the ureter. The umbilical artery is shown as a curved line, and the ureter is shown as a straight line passing beneath it. A branch of the umbilical artery is shown crossing over the ureter.

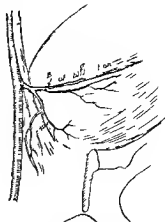


Fig 8. Illustration of the relationship between the umbilical artery and the ureter. The umbilical artery is shown as a curved line, and the ureter is shown as a straight line passing beneath it. A branch of the umbilical artery is shown crossing over the ureter.

the umbilical artery determine their future relation hip to the ureter. Thus a branch arising near the beginning of the umbilical artery would be apt to have a more intimate relationship to the ureter than one arising in the more distant portion of that vessel. This is schematically illustrated in Figure 6. Occasionally a branch extends backward to cross the ureter posteriorly. The origin and course of the hypogastric artery and its branches in their relation to the ureter have been found to be important factors in determining the possibility of ureteral compression.

In two instances as shown in Figure 7 the unobliterated part of the hypogastric artery, which was less than a centimeter in length, was found to break into a group of vesical arteries radiating like the spokes of a wheel crossing over the ureter and on to the bladder. Each vessel as it crossed the ureter could be seen to be attached to it. Many types of variations as to the origin of the vesical artery and their branches as well as to their distribution were found in different subjects and even in the same subject.

Another type (Fig 8) of which several were found shows one branch passing over the ureter externally while another branch encircles it in the opposite direction by passing beneath it. The last two types are illustrative of the potential source of obstruction to a fair sized calculus.

To date a summary of our dissection of twenty bodies shows that the hypogastric artery taking its origin 10 to 11.5 centimeters above the ureteral opening divides into an anterior and posterior branch. The former passes downward posteriorly to the ureter and divides 6 to 8 centimeters above the ureteral opening the so called mid pelvic stricture area of the ureter into an obturator and umbilical artery. From these vessels as well as the parietal branches two types of vascular anomalies have been observed. The first group by passing from the pelvis to the bladder wall may be a source of embarrassment in operations on this viscus. These are branches from the obturator artery or vein, a vein from the femoral vein and a branch of the posterior hypogastric artery passing on to the bladder wall. The second comprises those vessels which through proximity to the course of the ureter may interfere with the passage of calculi as in the case reported. These with or without reinforcing bands of fibrous tissue may have to be reckoned with as a causative element in stricture of the pelvic ureter. The vesical arteries taking origin from the umbilical artery have been seen to cross the ureter in many instances and have been found to vary not only as to site of origin but also as to course and distribution. While these vessels are often of small

caliber some are of large size and have been palpated through the bladder wall in the cruder in injected subjects

The work thus far seems to point the way to a logical explanation of some of the obstructive lesions of the lower ureter. Hunner¹ finds that there is a frequent association of ureteral stricture and venous phleboliths in the immediate neighborhood. In discussing the location of the stricture he finds the most frequent site to be within 6 centimeters of the bladder and the next in frequency at the bifurcation of the iliac vessels. He explains this by the location of glands along the iliac vessels and emphasizes the difference between these sites and the areas of congenital narrowings i.e. the pelvic brim and the intramural portion of the bladder. Our studies I believe explain the fact that a calculus may at times hang for a considerable period of time at the midpelvic portion of the ureter

—in area of the ureter which is normally of large caliber

SUMMARY

Obstruction of the lower or pelvic portion of the ureter can be produced by blood vessels which may be normal to the region but pursue an atypical course or by adventitious structures foreign to the location through which they run.

The possibility of vessel obstruction should be considered and borne in mind both before and at the time of operation.

Treatment is operative in a large percentage of cases and is based on the usual case history and careful urological examination.

Importance of the subject warrants careful investigation and future anatomical and clinical research.

For their efficient aid in carrying out the dissections referred to in this presentation I am indebted to and wish to thank Drs Harold D. Berlowitz and S. E. Kramer and for his courtesy and generous co-operation in permitting the use of the necessary anatomical material I wish to thank Dr. Charles Norris.

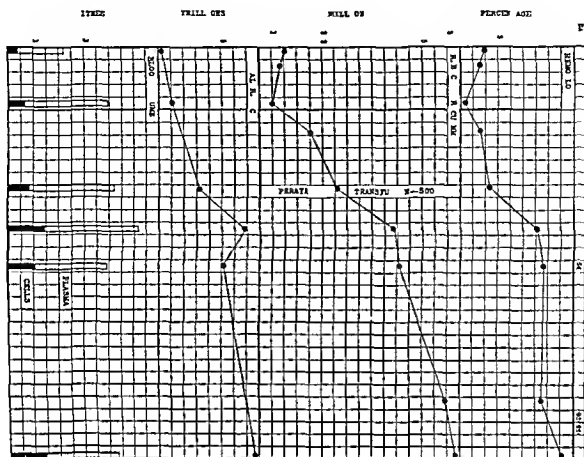


Fig. 1. A graphic representation of the effect of liver, a well balanced diet, and a transfusion of blood on the hæmo globin red blood corpuscle count per cubic millimeter, total number of red blood corpuscles, and blood volume in a case of anemia due to chronic hæmorrhage (S 29273). The vertical heavy black line shows where the dietary treatment was started.

blood volume were carried out according to the method suggested by Keith Rowntree and Geraghty (2) slightly modified as previously described by Murphy, Monroe and Fitz (7). The icteric index was estimated by the method previously suggested by one of us (6).

HÆMOGLOBIN AND RED BLOOD CORPUSCLES

The figures recorded in Table II show the course of the hæmoglobin and red blood corpuscles in the 11 patients treated with liver and the diet already described. The anemia in 10 of these cases was the result of chronic hæmorrhage varying in duration from 1 month to 8 years. The results in four representative cases (S 29273, S 28138, S 28107, S 8029) may be seen in graphic form in the first four figures. In one case (S 818) the anemia was due to acute hæmorrhage. The

result in this case is shown in Figure 5. Changes in the blood volume and in the total number of red blood corpuscles which are typical of the entire group are recorded in these figures and need no further comment. The rate and degree of rise in the red blood corpuscle counts are comparable to those recorded in pernicious anemia under similar treatment (3, 4, 7). In some instances however the increase in hæmoglobin lagged slightly behind the rise in red blood corpuscles. The color index remained below the usual normal level throughout.

The data obtained from the six patients to whom iron was administered in addition to the diet of liver, green vegetables, and fresh fruit are presented in Table III.

The records of the 7 control cases are summarized in Table IV. These patients were given no special treatment and received only the customary hospital diet. Two patients

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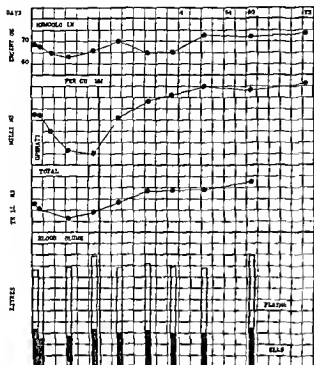


Fig. 2. A graph representing the effect of liver treatment on the blood of patient with chronic hemorrhage (Case S 8138). The graph shows the percentage of the initial value of the blood components at each time point.

(S 29273, S 8138) included in this group however later received liver and their subsequent course is shown in Table II and in Figures 1 and 2. The anemia in the cases presented in Tables III and IV was the result of chronic hemorrhage in each instance with the exception of cases S 29085 and S 6856 in which it was due to acute hemorrhage. Both of these cases appear in the control group and should give this group an advantage.

A comparison of the changes which occurred in the blood as shown in these tables is of considerable interest. Unfortunately it was impossible to record cases in the untreated control group which had been followed for longer than 2 weeks. A glance at the columns recording the hemoglobin and red blood corpuscles in the three tables during a 4 weeks period however will reveal a striking contrast between the definite increases noted in Tables II and III and the very slight increases recorded in Table IV. Fourteen or 82.3 per cent of the 17 patients whose figures are recorded in Tables II and III showed a definite increase in

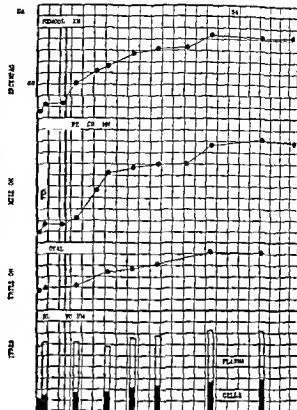


Fig. 3. A graph representing the effect of liver treatment on the blood of patient with chronic hemorrhage (Case S 8138). The graph shows the percentage of the initial value of the blood components at each time point.

the percentage of hemoglobin. Sixteen patients or 94.1 per cent showed an increase in red blood corpuscles. Four or 23.5 per cent of the 17 patients in the control group (Table I) showed an increase in hemoglobin and only 3 or 17.6 per cent showed any increase in red blood corpuscles. Eleven or 64.7 per cent of the patients treated with liver or liver and iron had an increase of 10 per cent or more in hemoglobin and 14 or 82.3 per cent showed an increase of 500,000 or more red blood corpuscles per cubic millimeter during the first 2 weeks after dietary treatment was instituted. In the same interval of time only 3 or 17.6 per cent of the control patients showed a rise of 10 per cent in hemoglobin and only 3 or 17.6 per cent had an increase of 500,000 red blood corpuscles per cubic millimeter. Although it is not possible to compare the groups at the end of one month of treatment it is of interest to note the striking increase which occurred both

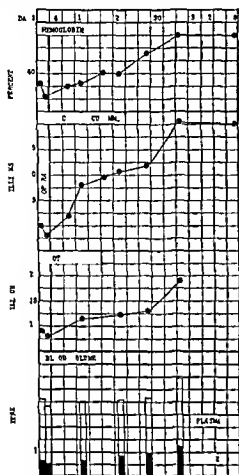


Fig. 4. Case S 2809. Anæmia due to chronic hæmorrhage. The regeneration of hæmoglobin was less prompt than the increase in red blood corpuscles. The patient received liver and the special diet but no iron.

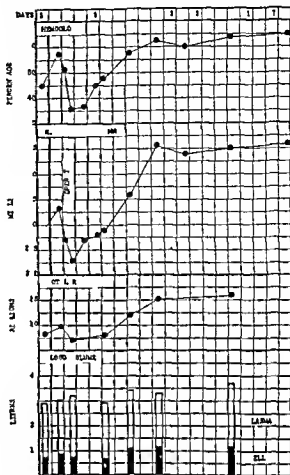


Fig. 5. Case S 2882. Anæmia due to acute hæmorrhage. The patient lost 500 cubic centimeters of blood during the operation. Regeneration of both hæmoglobin and red blood corpuscles was very rapid.

in percentage of hæmoglobin and in red blood corpuscles during such a short period of time. Those patients who were followed for 2 and 4 months continued to show a very gratifying improvement with the exception of two patients (S 2930, S 29570) whose red blood corpuscle counts became normal at the end of 4 months but whose percentage of hæmoglobin remained persistently low. Clinical improvement was also less striking in these two cases.

The averages for each group shown at the bottom of the tables are quite convincing evidence of the value of liver together with a well balanced diet in the treatment of this particular type of anæmia. During the first 2 weeks the total average increase in the percentage of hæmoglobin and in the red blood corpuscle count of the patients receiving liver was respectively 8.6 per cent and 1,000,000 cells per cubic millimeter. In the group

treated with liver and iron the hæmoglobin increased 13.8 per cent and the red blood corpuscles made a total average gain of 600,000 per cubic millimeter. In the untreated group the average increase in hæmoglobin was only 3 per cent; the red blood corpuscles decreased 100,000 per cubic millimeter. At the end of one month the patients who received liver had gained an average of 19.2 per cent in hæmoglobin and 1,700,000 red blood corpuscles per cubic millimeter. Those treated with liver and iron had gained an average of 26.2 per cent in hæmoglobin and 1,500,000 red blood corpuscles per cubic millimeter.

The cases in the three groups are essentially comparable in all respects. The average initial level of the hæmoglobin and red blood corpuscles was lower in the group treated with liver than in the other two groups; the average in the control group was slightly higher than in

TABLE 1—SUMMARY OF THE ESSENTIAL FACTS CONCERNING EACH OF THE SEVENTEEN PATIENTS TREATED WITH LIVER OR LIVER AND IRON

| N | | I
l f m h f | I
l | Op |
|-----|---|----------------|----------------------|----------------------------|
| | | m h m t
m h | k l m f
m m | S p my S l p n
ph f m |
| | | k m
m h f f | I b m f
Hyp f l m | T h l h d h y l
f R l m |
| | | l f | I l m f | D l d |
| | | m l | A l o c m f m | N l m |
| 5 | | l | A b m l | D l d |
| | | m h m | P y | l my |
| 8 | 7 | l m | l h | N |
| 8 9 | | m h m o l | Hyp f d m | D l d |
| | | m | l h d s | l m r h d m |
| 96 | | l y m l | E d m h | D l d |
| 67 | 7 | l y m | E l h m f | l m h l m |
| 5 | | l k m l | I b m f | D l d d m |
| P | 3 | m l | E d m h | D l d |
| | | y m | I b m f | l h l m |
| | | 7 m m | l h | N |
| 6 | | m h m | I l m l | p m l h y
o e h l p m |
| | | m l | I l m f | p m l h
l m y e c m |
| 85 | | l l | l | l o u t h m |
| | | m h m l | M r h | N |
| 85 | | k m l | P g | D l d l p n
o e h e c m |
| | | l | H l p f l m | o e h m l h
m m l m |

the other two. This perhaps suggests that a smaller increase might be expected in the control patients than in those treated with liver or with liver and iron. However the contrast is greater than one would expect for there was actually very little gain in any case of the control series. Whereas the patients treated with liver with or without iron had made an essentially comparable gain in red blood corpuscles at the end of 2 weeks and 1 month those treated with liver and iron had a distinctly higher average gain in percentage of hemoglobin at the end of both periods. These observations suggest that anemia resulting from chronic hemorrhage may be treated satisfactorily by the administration of liver and that the production of hemoglobin may be hastened by the addition of large doses of iron. An increase in red blood corpuscles may not be accompanied by a rise in hemoglobin and vice versa. Treatment must be instituted which will stimulate the regeneration of both elements if the best results are to be expected.

BLOOD VOLUME AND ICTERIC INDEX

Determinations of the blood volume were carried out at frequent intervals in the 11 patients treated with liver and serve to confirm the increase shown by the red blood corpuscle counts. The change in total blood volume were in most instances relatively small and very largely proportional to the increase in corpuscle volume. Representative determinations are shown in the accompanying figures. Figure 1 shows data concerning an interesting change in blood volume which followed a transfusion of blood given on the twentieth day after the dietary regimen was started. On the ninth day after the transfusion both the corpuscle volume and total blood volume were definitely increased over that recorded just prior to transfusion but by the eighteenth day both had fallen considerably. These changes are reflected by comparable alterations in the percentage of hemoglobin and red blood corpuscle count. The ultimate result however appears to be very similar to that obtained in the other cases.

Repeated determinations of the icteric index were made in 12 cases. In 9 of these the reading was below the average normal index

TABLE II—THE EFFECT OF LIVER AND A WELL BALANCED DIET ON THE FORMATION OF HEMOGLOBIN AND RED BLOOD CORPUSCLES IN ELEVEN CASES OF ANÆMIA DUE TO HÆMORRHAGE

| No. | Admission | | Two weeks | | | | One month | | | | Two months | | | | Four months | | | |
|------|------------|-----|------------|-----|--------------------|-------------|------------|-----|--------------------|-------------|------------|-----|--------------------|-------------|-------------|-----|--------------------|-------------|
| | Hemoglobin | RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC |
| 973 | 7 | 5 | 7 | 8 | | 3 | 46 | 30 | 0 | 4 | 48 | 50 | 3 | 35 | 73 | 55 | 56 | 4 |
| 94 | 6 | | 5 | 9 | | 3 | 9 | 35 | 3 | 5 | 4 | 3 | 8 | | 5 | 45 | 35 | 3 |
| 338 | 66 | 3 | 65 | 4 | | | 73 | 45 | 7 | 5 | 74 | 46 | 8 | 6 | | | | |
| 7980 | 35 | 7 | 3 | 7 | | | 4 | 35 | | 8 | 5 | 34 | 5 | 7 | | | | |
| 994 | 33 | 34 | 4 | 46 | 7 | | 54 | 5 | | 6 | 8 | 54 | 47 | | | | | |
| 8 | 45 | 0 | 59 | 36 | 3 | 7 | 6 | 44 | 5 | 5 | 6 | 46 | | 7 | | | | |
| 87 | 5 | 3 | 74 | 44 | | | 76 | 45 | 4 | 3 | 8 | 49 | 8 | 7 | | | | |
| 8039 | 6 | 8 | 75 | 4 | 5 | | 8 | 45 | | 7 | | | | | | | | |
| 89 | 3 | 8 | 4 | 4 | 9 | | 55 | 5 | 4 | 3 | | | | | | | | |
| 949 | 3 | 3 | 5 | 45 | 8 | 4 | 7 | 47 | 39 | 6 | | | | | | | | |
| 6496 | 4 | 9 | 55 | 14 | 5 | 5 | 7 | 4 | 3 | | | | | | | | | |
| Avg | 38.8 | 6 | 47.4 | 36 | 8.6 | | 53 | 4 | 9 | 6 | 6 | 43 | 7 | 8 | | | | |

There was no constant increase in the figure as the blood approached normal. In two cases (S 29094 and S 29085) in which the red blood cells and hemoglobin were only slightly reduced the icteric index was normal. In one case (S 28017) the initial reading was slightly above normal but the color of the serum fell to below normal during a period of about 10 days. The anemia in this case was largely the result of a ruptured tubal pregnancy with an

initial count of 300,000 red blood corpuscles per cubic millimeter.

DISCUSSION

It is probable that liver contains many substances valuable to the metabolic processes of the body which are not contained in the liver extract effective for pernicious anemia. One should not conclude that the results reported here concerning liver would hold true for simi-

TABLE III—THE EFFECT OF LIVER, LARGE DOSES OF IRON, AND A WELL BALANCED DIET ON THE REGENERATION OF HÆMOGLOBIN AND RED BLOOD CORPUSCLES IN SIX CASES OF ANÆMIA DUE TO HÆMORRHAGE

| No. | Admission | | Two weeks | | | | One month | | | | Two months | | | | Four months | | | |
|------|------------|-----|------------|-----|--------------------|-------------|------------|-----|--------------------|-------------|------------|-----|--------------------|-------------|-------------|-----|--------------------|-------------|
| | Hemoglobin | RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC | Hemoglobin | RBC | Icteric hemoglobin | Icteric RBC |
| 3667 | 33 | | 46 | 4 | 3 | | 68 | 3 | 35 | 0 | 33 | 4 | 5 | 0 | | | | |
| 957 | 3 | 3 | 36 | 36 | 6 | 4 | 55 | 34 | 5 | | | | | | 55 | 48 | 5 | 6 |
| Pt | 5 | 3 | 65 | 3 | 5 | 9 | 75 | 5 | 5 | 7 | | | | | 9 | 5 | 4 | 8 |
| 77 | 45 | 3 | 55 | 4 | | | 65 | 5 | | | | | | | | | | |
| 750 | 35 | 34 | 57 | 4 | | 6 | | | | | | | | | | | | |
| 966 | 44 | 39 | 6 | 45 | 7 | 6 | | | | | | | | | | | | |
| Avg | 39.5 | 3 | 53.3 | 36 | 3.8 | 6 | 65.7 | 4 | 6.2 | 5 | | | | | | | | |

TABLE IV.—THE RATE OF FORMATION OF HÆMOGLOBIN AND RED BLOOD CORPUSCLES IN SEVEN UNTREATED CASES OF ANÆMIA DUE TO HÆMORRHAGE

| | Adm | | T | | | | O m h | | | |
|----|-------|------------|---------|-----|---------|-----|-------|-----|---------|-----|
| | H m l | RBC m l bo | H m l b | RBC | H m l b | RBC | H m l | RBC | H m l b | RBC |
| | | | 5 | 5 | | 6 | 65 | | | 6 |
| 85 | | | 63 | 36 | — | | 73 | 3 | | |
| 99 | | | 66 | | — | | | | | |
| | 5 | 8 | 7 | 5 | —8 | | | | | |
| | | | 5 | | | | | | | |
| 86 | 55 | 5 | | | | | | | | |
| | | | 55 | 5 | 5 | | | | | |
| A | 5 | | | 3 | | | | | | |

lar cases treated with extract. The value of liver extract which is effective for pernicious anæmia is yet to be determined in cases of anæmia due to chronic hæmorrhage. Observations made by Whipple on dogs rendered anæmic by controlled bleeding suggest that liver extract Number 343¹ (11) has a different effect on these animals than comparable amounts of whole liver. His observations suggest that a small amount of whole liver given with the extract is more effective in enhancing blood regeneration than equivalent amounts of the extract alone.

SUMMARY AND CONCLUSION

Observations are recorded showing the rate of formation of hæmoglobin and red blood corpuscles in a series of 24 cases of anæmia due to loss of blood. Hæmorrhage in all except three cases was of a chronic nature.

Seventeen patients were treated with large amounts of beef or calves liver together with a diet containing green vegetables fruit and red muscle meat. Six of these patients received in addition large doses of iron. Seven control patients received neither iron nor a special diet. These seven patients showed very little change in the concentration of either

hæmoglobin or red blood corpuscles during a period of 2 weeks. The 17 patients treated with liver or liver and iron showed a definite increase in both hæmoglobin and red blood corpuscles in all except three cases. The patients treated with liver and iron had a greater increase in hæmoglobin than did those treated with liver. Those patients receiving liver who were followed from 1 to 4 months continued to show improvement comparable to that observed during the first 2 weeks with the exception of two patients whose percentage of hæmoglobin remained persistently low.

From these observations it appears justifiable to conclude that liver together with such a dietary regimen as that described stimulates the formation of hæmoglobin and red blood corpuscles in patients with anæmia due to chronic hæmorrhage. The formation of hæmoglobin is still further increased by the addition of large amounts of iron to this diet.

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the at J B l Ch m 98 lxxv 97
2. KEITH M. R. W. T. E. L. G. d G. R. G. T. V
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CLINICAL SURGERY

FROM THE SURGICAL CLINIC OF PROFESSOR R. LLRICHE STRASBOURG

TECHNIQUE OF LEFT EPINEPHRECTOMY

I. STULZ M.D. AND I. STRICKER M.D. STRASBOURG FRANCE

SURGERY of the thyroid gland which was the starting point of endocrinological surgery which 50 years ago boasted no fixed rules and which was considered highly dangerous has rapidly added to our knowledge of thyroid diseases. We may therefore assume that the surgery of the adrenal system may also elucidate pathological problems of the first importance that are yet but little known.

The fact that the adrenals are not easily accessible should not be at the present state of surgical development a stumbling block to the surgeon. That there are two adrenals is most advantageous for although excision of one gland results in a marked reduction of adrenal tissue it does not endanger life.

Besides extirpation of an adrenal for new growth several surgeons have undertaken epinephrectomies in order to cure epilepsy. Delbet following an idea of Vaquez did the operation in order to influence arterial hypertension. Von Oppel was the first to propose epinephrectomy in cases of spontaneous gangrene of the extremities. Since 1925 Professor Leriche (3, 4) has studied the influence of left epinephrectomy in thromboangitis obliterans (Buerger's disease) and in different vascular syndromes (Raynaud's disease, permanent cyanosis).

We believe that the time has come to publish the particulars of the technique applied in Professor Leriche's clinic and will therefore endeavor to give a resume of the technique employed in the 13 operations witnessed by us and of the detailed anatomical studies on 4 amphitheater subjects.

The left adrenal is more easily extirpated than the right one since the latter is situated in immediate proximity to the vena cava and is overhung by the liver. There are several ways by which to reach the left adrenal. Some authors for instance Bruening and von Oppel have advised the transperitoneal route but this technique has all the drawbacks of any laparotomy on deep

organs. Furthermore it would not be very logical to follow this route in an operation on a gland which is not enlarged and which therefore does not protrude into the peritoneal cavity. The transperitoneal method should be followed only in cases of voluminous tumors of the adrenals.

We must further keep in mind that the usual incisions for renal approach are of little or no use since they do not sufficiently expose the upper part of the kidney and the adrenal. On the other hand approach to the gland through the back is not to be thought of since such an approach would involve the risk of penetrating the pleural cavity. Logically the adrenal must be approached through a lateral extraperitoneal incision which must be higher up than that used for renal operations and yet sufficiently low to avoid the pleural risk.

TECHNIQUE OF OPERATION

The patient is anesthetized and placed as for a left nephrectomy on a lumbar support of the Pillet type which can be raised at will. The right leg is kept flexed, the left stretched, the plane supporting the lower limbs is inclined so that the costo iliac space is widened as much as possible.

The surgeon stands behind the patient, his first assistant stands opposite him and on his left, that is to say toward the patient's feet, the second assistant stands opposite the operator and on his right but nearer the patient's head.

A lateral incision is used. The incision is from 12 to 15 centimeters (exceptionally 20 centimeters) long (Fig. 1) commences one or two fingers' width from the outer border of the left rectus abdominis slightly above or at the level of the umbilicus, runs toward the upper margin of the twelfth rib, strikes it under an acute angle, crosses the rib and ends near the external border of the erector spinae muscles. The incision therefore divides the subcutaneous cellular tissue and the muscular masses of the obliquus externus, obliquus internus and latissimus dorsi.

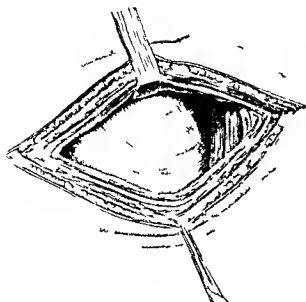


FIG. 1 Exposure of the kidney in its pocket

DIFFICULTIES ENCOUNTERED

The technique described cannot always be followed in every particular. In most cases it is possible to remove the adrenal in one intact piece but sometimes especially in very obese patients the depth of the wound and the friability of the gland make fragmentation necessary. The adrenal does not always have a fixed position with relation to the kidney and the neighboring organs so one must not expect to find it at once. As a rule its position is adrenal but we must bear in mind that it does not always closely follow the kidney when this organ is pulled downward. If strong adhesions are present it may be found very high up under the cupola of the diaphragm and its upper margin may be so far from the incision as to make freeing difficult. In other cases the adrenal may be found stretched along the posterior surface of the kidney in the immediate neighborhood of the aorta. This position may be an indication for the liberation of the anterior face first.

As to the vascular pedicles it is not always possible to see all of them or to secure them individually. It must be kept in mind that they often are quite thin and reach the gland after having ramified. The pedicle that can be ligated in most cases is the hilar one which is the most voluminous. If the vein lies too deep down to be ligated there is no harm in leaving it as the venous hemorrhage usually stops of its own accord.

When the adrenal is found in a low position it may be necessary to leave the hilar part in its place and to insure hæmostasis beneath it by

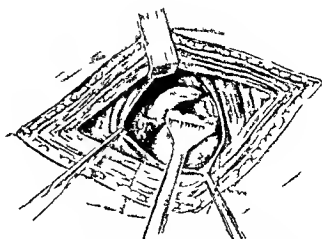


FIG. 3 The fatty capsule has been opened high up. The kidney is pushed downward and forward so that the base of the adrenal is visible.

encircling it with catgut. Section is done above the ligature.

While seeking for the gland one may observe a layer of brownish fat of a shade very much like that of the adrenal. This color has no pathological significance, the fat being histologically constituted of very small and quite sound fat cells.

In the first stages of the operation it may sometimes be difficult to identify the upper pole of the kidney especially in cases of ptosis. In this eventuality the spleen takes the kidney's place and can be seen through the pellucid peritoneum. Care must be taken not to mistake the spleen for the kidney and incise the peritoneum so as to search lower down and behind. It is not likely that the cauda pancreatis will be mistaken for the adrenal since the pancreas has a grayish color and is much harder than the adrenal.

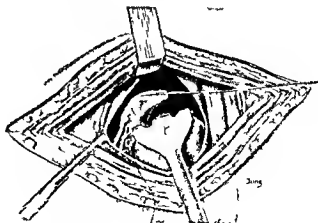


FIG. 4 The retractor pulls the kidney down and backward. The anterior surface of the adrenal with the vein is freed.



Fig. 2. Sh. g. th. l. f. n. c. s. o.

The twelfth rib is resected for a length of from 5 to 8 centimeters. The lower part of the serratus posterior inferior and the fascia of the transversus abdominis are incised. In the anterior half of the incision there appears the subperitoneal fat; in the posterior half of the incision there appears the kidney pocket (Fig. 2). The whole mass is then separated from the posterior muscular layer.

The right hand is then introduced into the wound and gropes for the kidney, which is reached by its lateral border and anterior surface. When the kidney has been identified the fatty capsule is opened by an incision of the fascia of Zuckerlandl near the inner border of the upper pole of the kidney and is then freed from the perirenal fat. With a big retractor the kidney is pushed downward and forward in the direction of the pubis so as to facilitate the exposure of the subphrenic space. This manipulation at the same time drags down the adrenal which is still wrapped in its fat by means of the capsular pedicles that branch from the renal vessels.

The gland is then searched for in the epirenal fat and its base which faces downward backward and outward is usually discovered first (Fig. 3). The adrenal tissue is recognized by its yellow tint and is easily differentiated from fat. Care must be taken not to put a clamp or even a sponge holding forceps on this most friable glandular tissue. Instead the gland should be freed by blunt dissection with a dissector. After the dissection has been carried out for a certain length of time the greater part of the base of a segment of the anterior surface of the organ are seen. Its upper margin where the upper vascular

pedicle (from the arteria phrenica inferior) reaches the gland is also noted. Two ligatures are then carried around this pedicle and tied. The pedicle is divided between the ligatures. The part of the ligature nearest the gland is kept long and traction on it permits the progressive freeing of the posterior surface, the anterior surface and the inner border of the organ from which numerous nerve threads run toward the ligamentum semilunare. These fine nerves are often cut or torn during the freeing of the inner border.

In order to obtain a good view during the freeing of the anterior surface and the inner border of the gland one must displace the retractor which until now has been kept on the upper pole of the kidney; its posterior face pulls the organ toward the pubis. The retractor is next put on the upper pole and the anterior part so as to pull the organ downward and backward. During the first step of the operation the kidney pivots on its longitudinal axis and thus shows its external border. Now it is pushed straight downward toward the anterior superior iliac spine. This manipulation combined with slight traction on the ligature allows the operator to see the anterior surface of the adrenal. After the fat has been bluntly dissected away from this face the vena suprarenalis is seen entering the gland and its hilus situated on the anterior face near the inner border (Figs. 4 and 5). The vein is cut between two ligatures. The arteria capsular inferior runs parallel to the vein and can be secured by the same ligature.

Since the gland is now almost totally free it is pulled toward the operator by the long ligature; a needle is run through its lower and inner part and a massive ligature tied. The gland is sectioned above this ligature; the knife being directed toward the kidney. A part of glandular tissue is left behind because of the possibility that the right adrenal may be absent or difficult to find (Fig. 6). The total weight of the adrenal is about 4 grams; hence there is left from 1 to 1 gram of glandular tissue.

After a thorough revision of the wound and accurate control of hæmostasis the wound is closed by sutures as a rule without drainage. The closure is completed in four layers: the first of which closes the incision of Zuckerlandl's fascia. The dislocated kidney regains its normal position without any special measure of fixation. Then follows the suture of muscles which is done in two layers: the lumbar support having been first taken away. The skin is sutured in the usual manner.

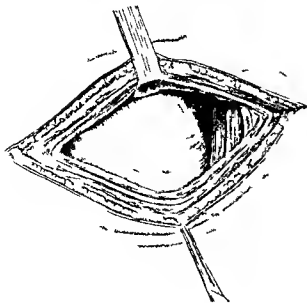


Fig. 1 Exposure of the kidney in its pocket

DIFFICULTIES ENCOUNTERED

The technique described cannot always be followed in every particular. In most cases it is possible to remove the adrenal in one intact piece but sometimes especially in very obese patients the depth of the wound and the friability of the gland make fragmentation necessary. The adrenal does not always have a fixed position with relation to the kidney and the neighboring organs so one must not expect to find it at once. As a rule its position is adrenal but we must bear in mind that it does not always closely follow the kidney when this organ is pulled downward. If strong adhesions are present it may be found very high up under the cupola of the diaphragm and its upper margin may be so far from the incision as to make freeing difficult. In other cases the adrenal may be found stretched along the posterior surface of the kidney in the immediate neighborhood of the aorta. This position may be an indication for the liberation of the anterior face first.

As to the vascular pedicles it is not always possible to see all of them or to secure them individually. It must be kept in mind that they often are quite thin and reach the gland after having ramified. The pedicle that can be ligated in most cases is the hilar one which is the most voluminous. If the vein lies too deep down to be ligated there is no harm in leaving it as the venous hemorrhage usually stops of its own accord.

When the adrenal is found in a low position it may be necessary to leave the hilar part in its place and to insure hæmostasis beneath it by

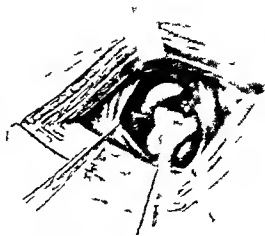


Fig. 3 The fatty kidney is pulled down the adrenal is exposed

encircling it with catgut the ligature

While seeking for the a layer of brownish fat like that of the adrenal logical significance the constituted of very cells

In the first stages of sometimes be difficult to of the kidney, especially eventually the spleen and can be seen through the Care must be taken not to the kidney and incise search lower down and that the cauda pancreatis adrenal since the pancreas is much harder than the

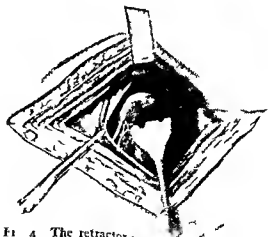
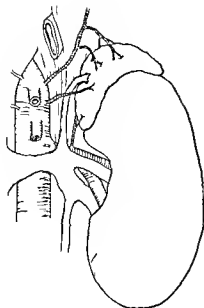


Fig. 4 The retractor pulled backward The anterior surface of the adrenal is exposed



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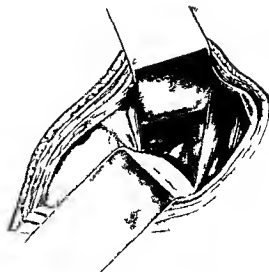
DANGERS TO BE AVOIDED

In 1 operation which have been performed the pleura has never been injured. Only once during operation on a cadaver did this mishap occur because the incision was made much too high and too far posterior—between the eleventh and twelfth rib. The peritoneum was opened once but without any serious result. This accident does not occur when care is taken to split the fatty capsule of the kidney far behind.

The larger vessels have never been touched but one must beware of the aorta and especially the renal artery. Blunt dissection will prevent any accident.

POSTOPERATIVE CARE

As a rule the postoperative course is normal. The patients are practically apyretic. They never suffer from shock and recovery is rapid. In 5 per cent of the cases we were obliged to leave a gauze wick in place but were able to remove it on the fifth day. During the first days following the operation there may be some slight meteorism which is easily relieved by hypophyseal extracts.



1. 6 Aft p at n th f pole f the ad 1

Patients may get up about 12 or 15 days after the operation.

One of our patients developed a hypothermia which lasted about 12 days (rectal temperature was about 36 degrees C) in another patient a slight pleural reaction with sterile exudate was noted but this disappeared after puncture. In a third case polyuria lasted for 3 weeks and the patient passed from 2100 to 2500 cubic centimeters of urine daily.

The operation may in truth be considered a not very dangerous. Twelve of our patients recovered without having shown a serious complication. One patient died on the third day as a result of a postoperative thrombosis of the aorta the result of an advanced atheromatosis of the aorta abdominalis and the iliac vessel.

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FROM A SURGICAL UNIT OF THE MELBOURNE HOSPITAL

OPERATION FOR THE CURE OF OBLIQUE INGUINAL HERNIA

ALAN NEWTON MS (MFLB) FRCS (Eng) FACS FCSA AND HENRY SEARBY MS (MFLB)
FRCS (Eng) FCSA MELBOURNE AUSTRALIA

FOR nearly 30 years R Hamilton Russell has reiterated that oblique inguinal hernia is due solely to the partial or complete failure of obliteration of the processus vaginalis testis but it is only recently that his views have begun to receive the recognition that they merit. More over there are some surgeons who accept his theory but do not put it into practice in the operating theatre.

Russell's theory may be summed up as follows. No pre formed sac no oblique inguinal hernia. He has shown that mankind is divided into three groups (a) those in whom the processus vaginalis is completely obliterated and who are therefore immune from oblique inguinal hernia (b) those in whom there is partial or complete failure of obliteration of the processus and who are therefore potential cases of oblique inguinal hernia and (c) those who actually suffer from oblique inguinal hernia.

It logically follows that the effective surgical treatment of oblique inguinal hernia depends upon the complete removal of the sac with as little interference as possible with the muscular structures of the region. The majority of surgeons still resort to more or less elaborate methods of suturing the inguinal region but such methods are based on the erroneous assumption that oblique inguinal hernia is due to muscular weakness. It is true that muscular weakness is the cause of a direct inguinal hernia but it plays no part in the production of the oblique variety. In the operation for oblique hernia these suturing methods are positively harmful because they weaken the abdominal wall in the inguinal region by converting muscle into non contractile fibrous tissue and so predispose to the later development of a direct hernia. We have seen several such cases in the last few years. In the living subject the arched lower fibers of the internal oblique and transversalis muscles act as a sphincter during effort they contract so that the gap seen in the cadaver between them and Poupart's ligament is obliterated. It seems to us illogical to interfere with this mechanism by the introduction of sutures.

If the sac be incompletely removed recurrence of the hernia is probable and the patient is dis-

charged from hospital as a potential hernia case. Such a recurrence does not mean that muscular weakness is present and can be permanently cured by a second operation for complete removal of the sac. Failure to remove the sac completely is most likely when an interstitial process of the sac is present. Knowledge of the various abnormalities of the processus vaginalis which have been well described by Hamilton Russell (2) will prevent the surgeon from making this mistake. In cases in which there is a very large hernia of long duration the musculature of the inguinal region is so weakened that it is necessary to repair it by some plastic operation such as that elaborated by Gallie (1). The confidence engendered by the successful results of complete sac removal alone has made it rare for us to resort to such methods in oblique inguinal hernia.

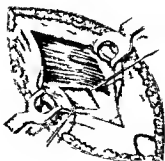
The operation we perform is based on the method first described by Hamilton Russell (3). It is best performed under local anaesthesia. The skin incision is made parallel to and 1 inch above



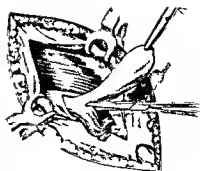
Fig. 1 Line of skin incision



F 1



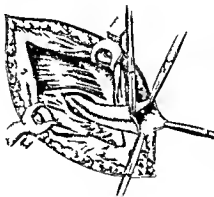
F 3



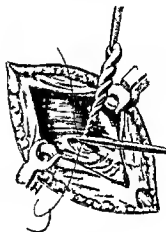
F 4



F 5



F 6



F 7



F 8



F 9

Poupart's ligament with its center over the internal ring (F1 1). It is unnecessary to carry the incision into the fatty tissue overlying the external ring for the skin can easily be retracted inwards so as to expose the ring. An incision is then made in the external oblique aponeurosis in the line of its fibers without opening the external ring thus leaving the intercrural fibers above this aperture intact (F1 2). A small incision is then made between the upper fibers of the cremaster and through the underlying fascia. The sac is thus

exposed and is readily recognized lying upon the cord (Fig 3). The cord is then delivered through the small opening and the sac separated from it by blunt and sharp dissection up to the level of the internal ring (Fig 4). Since the secret of success of the operation lies in the complete removal of the sac great care is necessary in defining its neck. While the sac is held firmly by forceps the vas is separated from it on its inferior aspect until the external iliac artery is easily felt. Then fascial adhesions are separated above and to the outer

side of the internal ring by sweeping a gauze covered finger under the arched lower border of the internal oblique (Fig 5) The sac is then turned outward and the separation continued on the inner aspect of the internal ring until a small pad of fat indicating the proximity of the urinary bladder is exposed

We attach considerable importance to the next step which consists in twisting the sac and at the same time pulling it forcibly upward in such a way that the peritoneum surrounding the internal ring is drawn into the twist For this reason the sac has been previously opened (Fig 6) so as to make sure that no viscus is adherent in the region of the neck Traction is maintained on the twisted sac while crushing forceps are applied at its base The latter is then transfixed and ligated with No 1 chromic gut in the groove formed by the forceps (Fig 7) The sac is cut across distal to the ligature and the stump then retracts about 2 inches above the normal position of the internal ring

Difficulty in identifying the sac may be experienced when the processus is open throughout (hernia into the tunica vaginalis total funicular hernia Russell 2) The following has been found to be an easy rapid and sure method of overcoming this embarrassment lift the cord up so that it lies across the palmar surface of the left index finger separate the vas and the vessels from

the remainder of the cord and transfer them to the dorsal aspect of the finger Lying upon the palmar surface of the finger will be the remainder in which the processus vaginalis must be located Clamp this remainder in a pressure forceps and cut it across distal to the forceps The forceps will now be grasping the upper portion of the divided processus its open mouth will be seen and it must be treated as the sac i e by stripping up to the internal ring by torsion crushing ligation and removal The lower portion of the processus leading to the tunica vaginalis testis should be disregarded in these cases

The small opening in the cremaster is closed by a suture (Fig 8) Three mattress sutures are then inserted in the incision in the external oblique aponeurosis (Fig 9) and the skin wound is closed The skin sutures are removed in 7 days and the patient is allowed to get out of bed in a fortnight

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RETROGRADE DILATATION OF THE OESOPHAGUS FOR CARDIOSPASM¹

E STARR JUDD M D F A C S PORTER P VINSON M D ROCHESTER MINNESOTA

AN
DANIEL P (REENLEE M D ROCHESTER MINNESOTA
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SINCE the introduction of improved methods of dilatation from above in cases of cardiospasm it has seldom been necessary to dilate from below. In approximately 1,000 cases of cardiospasm at The Mayo Clinic dilatation has been carried out readily and satisfactorily from above. In three cases the dilatation was done from below, one case in 1905 and two cases (those reported here) recently within a few months of each other.

Cardiospasm has been defined as spasm of the musculature of the cardia or epicardia sufficient to cause either partial or complete obstruction to the passage of food from the oesophagus into the stomach. It ranks next to carcinoma as the most common lesion found in the oesophagus. Purton first reported a case in 1871 and Zenker and von Ziemssen reviewed 17 cases from the literature up to 1878. Since that time due to improved methods of examining the oesophagus a great many more cases have been observed.

The etiology of the condition is not clear since constant factors have not been found in any group of cases. Broadly speaking there are two groups: (1) in which there is a sense of obstruction to the passage of food into the stomach without roentgen ray evidence of obstruction; such patients are likely to show psychoneurotic tendencies; and (2) in which there is definite obstruction to the barium meal although the symptoms may be as mild as in the first group; psychoneurotic tendencies are practically never manifested.

Plummer classified the disease into three stages: (1) cardiospasm without regurgitation of food; (2) cardiospasm with immediate regurgitation of food; and (3) cardiospasm and dilatation of the oesophagus with subsequent retention of food in the dilated part and its regurgitation at irregular intervals. Dysphagia for both solids and liquids is the most common symptom in contradistinction to benign or malignant strictures. Nocturnal regurgitation, epigastric pain which may antedate the onset of dysphagia, respiratory symptoms and hiccough are often present.

Vinson and Plummer (1911) stated that it is possible to make a diagnosis of cardiospasm at any age if dysphagia has existed for from 5 to 6

years without increase of symptoms if the patient is having as much difficulty with liquids as with solids without a history of previous trauma to the oesophagus and if roentgenograms reveal a smooth cigar tip type of obstruction at the cardia with or without dilatation of the oesophagus. If also a No. 45 French olive can be passed into the stomach guided by a previously swallowed silk thread without more than slight resistance at the cardia the diagnosis can be made practically with certainty.

The only effectual treatment of cardiospasm consists in forcible dilatation of the cardia. In the earlier days such ineffectual measures as the general care of the patient, bromides, a non-irritating diet, the passage of sounds and as a last resort gastrostomy were tried. Russell (1898) was the first to report a large enough series of cases to show the value of dilatation of the cardia with a silk covered balloon. Four of the seven patients treated in this manner were cured, one was greatly improved, one was not improved and one was not treated long enough to be benefited. Russell mentioned that he had seen Loretta of Bologna stretch the cardia from below in cases of cardiospasm and suggested that this might be tried when dilatation from above failed.

Dilatation by the hydrostatic dilator has been used in practically all cases at the clinic with good results. Dunham (1903) presented a method of dilating cicatricial stenosis of the oesophagus by having the patient swallow a silk thread which is brought out through a gastrostomy opening. Mixer (1909) simplified the technique by having the patient swallow enough thread so that it would pass through the stomach into the intestine and permit of its being drawn taut when dilatation was attempted. Plummer (1910) mentioned the importance of the silk thread in oesophageal work. The hydrostatic dilator is guided over a previously swallowed silk thread. The amount of pressure used depends on the degree of dilatation of the oesophagus. If only slight dilatation is to be carried out 20 feet of water pressure is used whereas with more extensive dilatation pressure to 24 feet of water is reasonably safe. The pain the patient expe-



Fig 1 Case 1 Enormous dilatation and angulation of the oesophagus after barium meal



Fig 2 Case 2 Marked angulation and dilatation of oesophagus

periences may be a guide as to the limits of safety but it is not infallible. One treatment by this method is effectual in 75 per cent of cases. In the remaining 5 per cent there is likely to be a return of trouble within a year and relief is obtained by further dilatation.

Mikulicz (1904) reported 4 cases, 2 of more than one and a half years' duration and 2 of about 9 months' duration (after operation) in which he had dilated the cardia from below with good results. Mikulicz' idea in treatment by manual dilatation of the cardia was to produce an effect similar to that seen when any sphincter is stretched to the point of paralysis. Mikulicz introduced long curved forceps, the blades covered with rubber, through the gastrostomy opening. The forceps were worked into the cardia and gradually opened until the maximal distance between the blades reached from 6 to 7 centimeters.

Erdmann (1906) reported a case in which he had dilated from below with excellent results. He made an incision along the long axis of the stomach large enough to introduce his hand but he was unable to locate the cardia. A bougie was then introduced from above through the cardia with the index finger following the bougie to the cardia. A second and finally a third finger was

introduced stretching the cardia from 4 to 6 centimeters. A year after the operation the patient had gained 35 pounds in weight.

REPORT OF CASES

CASE 1. A man aged 60 years came to The Mayo Clinic January 19, 1925, complaining of dysphagia of 38 years' duration. He dated the onset of trouble to drinking some cold lemonade which caused a tight substernal sensation and was relieved by regurgitation of the lemonade. Since then cold liquids or solids had always seemed to lodge under the lower end of the sternum. At times he was able to force food down by taking a large amount of fluid. The trouble had passed to a greater or lesser degree since the onset. He coughed and became quite blue with attacks of marked dysphagia and frequently regurgitated large amounts of mucus. He regurgitated food at night.

The patient weighed 145 pounds, a loss of 15 pounds compared to his weight at the onset of the trouble. A roentgenogram of the oesophagus showed cardiospasm with tremendous dilatation of the oesophagus.

Several attempts were made to dilate the cardia with the hydrostatic dilator but the lower end of the oesophagus was so angulated that it was impossible to introduce the instrument into the cardia even with the guiding thread. It was then decided to dilate the cardia manually from an approach through the stomach.

August 10, 1927, exploration was carried out, a diaphragmotomy performed. Following the thread one finger and then two were introduced into the cardia, thus dilating the oesophageal opening considerably. The patient was relieved of dysphagia and fluoroscopic examination showed very slight angulation of the barium meal at the cardia. After

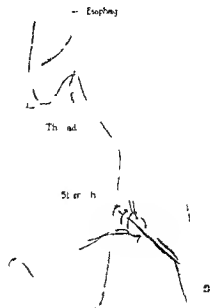


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SUMMARY

With present day method of treatment manual dilatation of the cardia through the stomach is seldom necessary but when used has proved successful

Failure to dilate the œsophagus from above was due to marked angulation of the lower portion of the organ. Most cases of marked angulation however have been readily treated with the hydrostatic dilator and symptoms have been relieved without any attempt at dilatation from below

The silk thread is just as valuable a guide to manual dilatation from below as it is to dilatation from above by means of the hydrostatic dilator

In one case in which there was recurrence of symptoms following manual dilatation from below the contour of the oesophagus had been altered sufficiently to permit hydrostatic dilatation from above

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INCISION OF THE THYROID ISTHMUS FOR RELIEF OF PRESSURE

FRANK H. LAHEY, M.D., F.R.C.S., BOSTON, MASSACHUSETTS

THYROIDITIS is a condition which certainly not infrequently terminates in myxedema. Therefore it is obvious that the removal of thyroid tissue in such cases is not to be deferred since the thyroid tissue that is still present is already infiltrated and limited in its capacity to produce thyroid excretion. Nevertheless there are circumstances under which thyroiditis can and does produce symptoms which may be relieved by a surgical procedure.

Thyroiditis with its round cell infiltration, its sticky consistency, and its later scar contraction occasionally produces constriction about the trachea sufficient in degree to occasion considerable discomfort. In considering how this constriction takes place, one must realize that the thyroid gland surrounds the trachea and is intimately adherent to it for at least two thirds of its circumference (Fig. 1).

As the result of infiltration and contraction many patients with thyroiditis complain of a marked sense of constriction in the throat with the advancing contraction of the organizing infiltration within the gland. In such cases also because of the stone-like hardness of the thyroid gland a suspicion of malignancy arises and the necessity of removing a portion of the gland for pathological examination and at the same time for relief of the constriction occasionally must be considered. In the presence either of carcinoma or thyroiditis the removal of the isthmus of the thyroid as shown in the illustrations (Fig. 2) accomplishes the results to be desired—the removal of the specimen and the relief of the constriction.

Little need be added to what may be seen in the illustrations except to urge that the entire isthmus be removed, not only that portion over the front of the trachea but that extending downward toward the side of the trachea so that the

entire front third of the trachea is bared and uncovered and so that sufficient thyroid tissue has been removed that the remaining lateral lobes are separately perched on either side of the trachea (Fig. 3) and so widely separated that they cannot bridge across the trachea, become united and again produce constriction. The removal of the isthmus should extend well back into the body of the lateral lobes (Fig. 2) so that a small wedge is removed from the body of the gland. This makes it possible to bring the cut surfaces of the lateral lobes together (Fig. 3) thus controlling oozing and at the same time limiting the bridge of scar tissue in front of the trachea.

The operation may be carried out through a short skin incision. There is very little bleeding to control since the infiltration and contraction which accompany the thyroiditis markedly diminish the vascularity of the gland.

It may rightly be said that removal of the isthmus of the thyroid will frequently fail to include other portions of the gland in which carcinoma is suspected, but when such is the case sections may readily be removed from any portion of the gland desired. Carcinoma of the thyroid gland when it has invaded the parenchyma of the thyroid gland itself is benefited but little by surgery. It is desirable however in many instances to ascertain whether the induration of the thyroid is due to carcinomatous infiltration or to the induration associated with the infiltration of thyroiditis, since even that carcinoma of the thyroid which is hopeless from the point of view of surgical cure may be greatly benefited by X-ray treatment and likewise since thyroiditis markedly diminishes the secretory activity of the thyroid, it becomes extremely important that X-ray therapy should not be applied in thyroiditis lest it lessen further a thyroid secretion already tending toward inadequacy.

There are certain features which are of assistance in endeavoring clinically to distinguish thyroiditis from carcinoma of the thyroid. Rarely may tenderness be elicited by pressure over the thyroid gland, which is the site of carcinomatous infiltration, while tenderness of some degree (usually slight) is rarely absent on pressure over the thyroid which is indurated as the result of thyroiditis. Carcinoma originating as it does so frequently from previously existing benign adenomata quite commonly involves only one lobe



Fig. 2. Diagram showing the central gland of the thyroid gland. The diagram illustrates the removal of the isthmus of the thyroid gland, leaving the lateral lobes separated. The central part is labeled 'Isthmus' and the lateral parts are labeled 'Lateral lobes'.

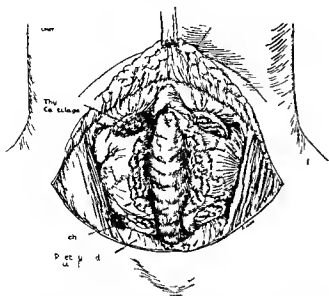


Fig. 1. Drawing showing the prethyroid muscles cut and ligated the isthmus removed and the entire front third of the trachea bared

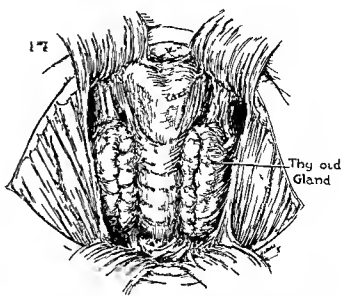


Fig. 2. The cut surfaces of the lobes have been sutured and widely separated so that they cannot be joined together again by scar and constriction thus recur

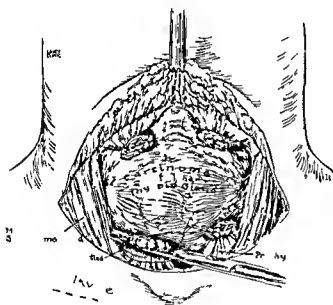


Fig. 3. Drawing indicating the relief from pressure which may be obtained (in carcinoma of the thyroid) by the severing and ligating of the prethyroid muscles. When possible the isthmus should also be removed and the trachea bared

while that thyroid which is symmetrically firm and indurated throughout its entire extent is quite likely to be so as the result of thyroiditis since the infiltration which accompanies this state tends to involve the entire gland rather than a lobe or a portion of it as is the case with carcinoma except in its late stages

A feature of additional value in thyroiditis is the fact that in the presence of carcinoma not in

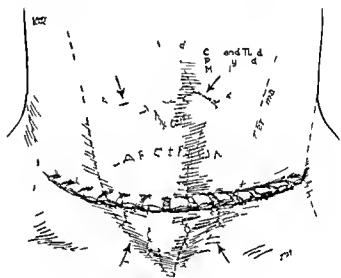


Fig. 4. The skin is closed over the ligature but uncut prethyroid muscles

frequently one lobe is first involved and this lobe is considerably larger than the other and in addition there is a change in its relative consistency. Enlargement of the neighboring cervical lymph glands is not characteristically associated with thyroiditis while with advancing carcinoma of the thyroid the appearance of enlarged and indurated neighboring lymph glands eventually occurs particularly when the carcinoma has already involved the parenchyma of the gland

Since myxedema so frequently eventuates in those patients whose thyroids are affected by

thyroiditis and since so many patients with thyroiditis give histories of throat infections two points should be emphasized first that as part of the plan of management of thyroiditis all throat infections particularly those arising in the tonsils should be cared for as a means of eliminating continued infection and second all patients with thyroiditis and especially their families should be warned of the probability of the later appearance of myxoedema whether any operation is undertaken or not thus relieving oneself of the frequently inferred responsibility for the later thyroiditis

Should the lesion prove carcinomatous should it have invaded the parenchyma of the gland and have occasioned tracheal pressure and constriction as it so frequently does then removal of the thyroid isthmus as here illustrated (Fig. 3) will give great relief and with proper X-ray therapy it will often be possible for the patient to exist comfortably for several months or years

Should the lesion prove to be carcinoma rather than thyroiditis the procedure shown in Figure 4 should be employed and in addition to removal of the thyroid isthmus the ribbon muscles over

the thyroid should be cut and tied close to their origin and the skin closed directly over the thyroid (Figs. 4 and 5) This results in such removal of pressure that considerable relief in breathing is often obtained in malignancy of the thyroid just as soon as the prethyroid muscles are cut It perhaps has a slight further advantage in that more direct approach to the thyroid malignancy for X-ray therapy may be had with only skin interposed between the apparatus and the carcinoma of the thyroid

SUMMARY AND CONCLUSIONS

Troublesome constriction about the trachea is not infrequently complained of by patients with thyroiditis

Thyroiditis can be relieved by removal of the thyroid isthmus The operative plan as employed in this clinic is illustrated and described in the legends

It occasionally becomes necessary to remove a specimen for pathological report in cases suspected of thyroiditis or malignancy in order that X-ray therapy may not further diminish the activity of an already inactive thyroid

TRISACRAL FUSION

AN OPERATIVE TECHNIQUE FACILITATING THE COMBINED ANKYLOSIS OF THE LUMBOSACRAL JOINTS OF THE SPINE AND BOTH SACRO ILIAC JOINTS¹

FRIMONT A. CHANDLER, M.D., I.A.C.S., CHICAGO

LUMBOSACRAL and sacro iliac strains subluxations and irritative lesions have received much attention in the literature of the past 20 years. Widely divergent views relative to the differential diagnosis between these conditions are encountered. In general there is agreement on certain fundamental considerations and these may be summarized as follows:

1. Sacro iliac and lumbosacral joints are true joints and as such are possible sites of lesions common to joints elsewhere in the body.

2. The lower lumbar and sacral regions are frequent locations of many and varied osseous developmental anomalies as well as widely varying mechanical components of the supporting structures of the vertebral column.

3. There is still much confusion as to the diagnostic syndromes differentiating lesions of the lumbosacral juncture from those of the sacro iliac joints.

4. Pathological conditions at both the lumbosacral juncture and the sacro iliac joints frequently coexist and their separate evaluation is very difficult if not impossible.

5. Relief of symptoms in many cases may be obtained from conservative measures such as postural corrections, physiotherapy, rest, medical supervision and external support. There are however many patients who are not relieved sufficiently or permanently and the resort to operative measures is justifiable.

6. Stabilizing operations of the lumbosacral and sacro iliac joints have a distinctly useful place among the therapeutic measures directed toward the relief of symptoms arising from the pelvic girdle and lower spine.

In a paper published in 1913, Dr. J. E. Goldthwait makes the following statement: "If the sacro iliac joint is involved as part of the lumbosacral malformation it is obvious that treatment directed to the sacro iliac joint will not bring relief. In such a case not only must the sacro iliac joint be supported but at the same time the body must be so poised that there is the least possible irritation at the lumbosacral joint as well as the least possible pressure of the transverse process against the sacrum and ilium. The terms strain or irritation might well be substituted

for malformation in the foregoing quotation.

Operations eliminating motion of the lumbosacral or sacro iliac joints have been devised and successfully employed by Hibbs, Albee, Smith, Peterson, Gaenslen, Campbell, Picque, Verrall and others. All of these procedures excepting that of Verrall are directed toward the bony bridging or fusion of the joint and differ only in the location of the bony bridge and method of securing it. Verrall's operation utilizes a tibial graft as a tie beam between the ilia.

The following operation was devised to permit the bilateral stabilization of the sacro iliac joints as well as the fixation of the lumbosacral juncture. The complete bilateral stabilization of the sacrum encompasses more sound mechanical principles than procedures limited to but one or two of the three joints involved.

OPERATIVE PROCEDURE

The patient is placed prone upon the operating table with a small sand bag under the lower abdomen thus reducing the lumbar lordosis.

A transverse crescentic skin incision (Fig. 1) is made along the posterior margin of the iliac crests crossing the midline one inch below the level of the posterior superior spine of the ilia. The subcutaneous tissues are divided along the same line until the gluteal and sacrospinal fasciae are exposed. The convex flap is then dissected from the fascia in the midline only sufficiently to expose the tips of the spinous processes of the lower lumbar vertebrae. With proper retraction this can be accomplished without a wide detachment of the skin flap. The margins of the concave flap are freed at their lateral ends thus giving a good exposure of the posterior superior spines of the ilia.

Lumbosacral fusion. This stage of the operation in detail closely follows the technique of the Hibbs spine fusion operation. In brief the steps are as follows:

A vertical incision (Fig. 2) is made exposing the tips of the spinous processes of the fourth and fifth lumbar and first and second sacral vertebrae. The spinous processes of these vertebrae and contiguous laminae are then completely exposed posteriorly by subperiosteal dissection which is carried later

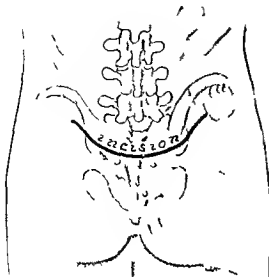


Fig. 4. Posterior view of the lumbar and sacral region showing the incision line.

ally exposed the margins of the lateral vertebral articulation. The interspinous ligaments as well as the ligamentum flavum are carefully curetted from between the adjacent laminae and the cartilage of the lateral articulation is removed with a small curette or chisel. Bone bridges are chiseled from the adjacent margins of the exposed laminae. These are interlocked, forming the interlaminar spaces (Fig. 4). The spinous processes are partially amputated but to a lesser degree than is done by Hall. The fragments of the spinous process are broken down thus supplementing the laminar bridge on either side. The midline incision is closed with two temporary sutures (Fig. 4) which approximate the fascia and peritoneum.

Sacrospinous. The attachments of the gluteal and spinous fascia are freed as in Figure 4 thus exposing the posterior superior spine of the ilium. The posterior superior spine of the ilium is split parallel to its flat surfaces and the outer portion reflected laterally, hinged by periosteum and gluteus maximus muscle at the level of the posterior margin of the sacro iliac joint (Fig. 5). The inner portion of the ilium is excised and after the portions of the posterior sacro iliac ligaments are divided, removed from the wound and preserved in normal saline solution for later use. At this stage moderate hemorrhage may occur but it is

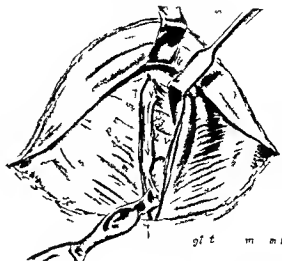


Fig. 5. Dissection of the sacrospinous region showing the reflection of the gluteal and spinous fascia and the division of the sacro iliac ligament.

readily controlled by hot packs and pressure while the opposite joint is attacked in a similar manner.

The periosteum of the posterior surface of the sacrum is elevated toward the midline (Fig. 6) and the cortex of the sacrum roughened by means of a small gouge. The posterior margin of the cartilage of the sacro iliac joint presents in the depth of the wound and is curetted thoroughly. Chips of cancellous ilium are placed across the sacro iliac joint posteriorly and the reflected bone flap of ilium is turned against the roughened surface of the sacrum and the periosteum of both iliac bone flap and sacrum is sutured (Fig. 7). The iliopsoas and gluteal fasciae are then closed securely. The opposite sacro iliac joint is attacked in a similar manner. The excised portion of ilium not used for chip grafts is split into two portions and placed through the midline incision so that it lies adjacent to the stump of the spinous processes (Fig. 7). The midline and lateral incisions are closed (Fig. 8) and the skin incision sutured with interrupted chromic catgut. A dressing and pad are applied and covered with oiled silk.

The detail of technique were worked out by repeated operation on the cadaver and have been found to be very satisfactory on subsequent clinical use.

The attached cancellous bone flap of ilium makes an ideal graft as it replaces the central portion of the posterior sacro iliac ligament. Increased instability of the sacro iliac joint theoretically present after division of the posterior iliac spine could not be demonstrated on the fresh



Fig. 3 Bony bridges are turned up spanning the interlaminal spaces. The lateral articulations are curetted and the spinous processes are partially amputated.

cadaver by direct manual pressure or by manipulation of the femur.

The operation of trisacral fusion makes possible the bony consolidation of the lumbosacrum and lower lumbar vertebrae. It has been found most practical to fuse the last two lumbar vertebrae to the sacrum although the extent of fusion should be determined by the individual case.

REPORT OF CASES

CASE 1. April 2, 1926. E. McG., age 41 years, single nurse. Patient complained chiefly of pain in the low lumbar region. She had had sciatic pain for 8 months. 11 months ago she first noticed pain in the lower back, especially while in bed or when she sat. She was moderately relieved on standing. At first the pain was of a dull aching character localized in the back. Later there was distinct radiation down the posterior aspect of the left thigh and leg, and to the toes of the left foot. The pain gradually increased in severity and more recently has extended down the right sciatic region. Tonsillectomy had been done in 1914 otherwise her past history was negative.

Examination reveals a well-nourished woman, moderate amount of dental work, tonsils removed, sinuses negative.

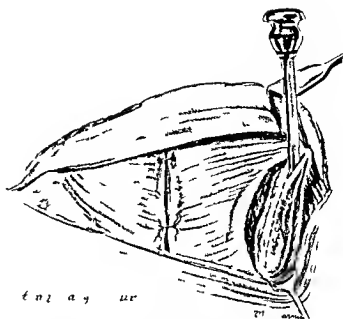


Fig. 4 The midline incision is closed with temporary sutures. The posterior iliac crest and spine are exposed and split to the level of the posterior margin of the sacroiliac joint.

lungs clear, heart normal, extremities negative, reflexes normal. The spine shows no lateral deviation but a moderate increase of normal curves. Flexion, lateral bending, and extension are restricted in the lumbar region. Acute tenderness to firm pressure is elicited in midline at lumbosacral juncture. No tenderness is noted when iliac crests or trochanters are compressed. Distinct lumbar pain is present on straight leg flexion at hips. The urine is normal. Temperature 98.6 degrees.

X-ray examination shows a moderately marked sacralization of the transverse processes of the sixth lumbar vertebra. The body of the fifth lumbar vertebra is slightly angulated downward to the left on the upper surface of the sixth. The lateral articulations at this level are irregular and without a tail. Both sacroiliac joints are widened and sclerosed with some spur formation at the inferior margin.

Diagnosis: chronic lumbosacral and bilateral sacroiliac strain, chronic secondary arthritis of the joints.

Operation. April 23, 1926. Fusion of the fifth and sixth lumbar and first sacral vertebrae was done as well as fusion of the right sacroiliac joint by the method described. The left sacroiliac joint was fused by the Smith-Petersen technique.

The postoperative course was normal except for urinary retention for the first 4 days. Patient was allowed up during the fifth week. X-ray films show heavy callus at lumbosacral and at both sacroiliac joints. The result 18 months after operation is excellent; patient has complete relief of symptoms.

CASE 2. Mabel B., 6 years old, married. Patient complained chiefly of pain in the lower lumbar region, the presence of which dated back 10 years to the birth of a child. The pain is limited to the lower lumbar region. There is no radiating pain. This patient was first seen by the author about 18 months previous to admission to hospital. At that time a diagnosis of chronic arthritis and strain was made. The patient was referred to Dr. H. O. Jones for gynecological care. An extensive pelvic and perineal repair was done but without any appreciable relief of low back symptoms. The patient was fitted with a corset which

X ray films taken on February 1927 showed the lateral articulations between the fifth lumbar to be of the oblique type. The joint margins were irregular and showed much new bone formation. Both sacro iliac joints were widened. The margins of the sacrum and ilia were distinctly sclerosed with small areas of localized bony absorption of the joint surfaces at the antero inferior aspect of the joints.

June 16 1928. There is evidence of new bone formation between the fourth and fifth lumbar and first sacral vertebrae. There is also evidence of bone production over the posterior aspect of both sacro iliac joints.

July 20 1928. Patient is completely relieved of backache. There is some stiffness of the erector spinae muscle groups. Movements of back are nearly normal and are painless. The patient states that she is very well pleased with outcome of operation and that she is more comfortable than she has been for the past several years. It is too early to predict end result but present result is most excellent.

CASE 3. H. C. age 17 years student was admitted to the hospital May 3 1928. One year ago he first noticed pain in the lumbar region after running into a fence while playing ball. Since that time he has had increasing discomfort in the lumbar region with frequent sharp radiation of pain down the posterior aspect of the right thigh to the level of the knee. He has been under the care of several physicians without securing relief. General history is otherwise negative except for surgical treatment of polydactylism.

General examination was negative. Examination of the spine revealed marked spasm of the erector spinae muscles moderate lumbosacral scoliosis to the left distinctly limited flexion and extension of the lumbar spine somewhat freer lateral bending. Distinct tenderness over both sacro iliac joints and at lumbosacral juncture. Some tenderness along the course of the right sciatic nerve. Some referred pain in the sacro iliac region on compression of the iliac crests and normal reflexes.

X ray films taken May 11 1928 show moderate spina bifida occulta of the first sacral vertebra moderate sacralization of the left transverse process of the fifth lumbar moderate sclerosis along the margins of both sacro iliac joints and the lower portion of the sacrum and coccyx irregular and deviated to the left.

Diagnosis sacralization of fifth lumbar vertebra chronic lumbosacral strain chronic sacro iliac strain.

Operation consisted in fusion of the fourth and fifth lumbar and first sacral vertebrae bilateral sacro iliac fusion by technique described. Postoperative course was uneventful. Patient was allowed up after 6 weeks wearing reinforced fabric corset.

X ray examination July 13 1928 showed much new bone present over posterior aspect of fourth and fifth lumbar and sacrum as well as over both sacro iliac joints.

Result immediate complete relief of pain in low back. This case is too recent to be considered as final result.

CASE 4. B. B. female single aged 40 years weight 145 pounds. Patient complains of weakness of lower lumbar region on which has been present for past 20 years and acute disabling pain in lower lumbar region since a fall down stairs 6 months ago. Previous to injury patient was enabled to carry on a normal existence by the use of a firm corset. Since injury brace and corset have been of no avail. The pain has been limited to the lumbosacral region particularly especially in the midline. Radiation of pain is absent. Some relief experienced on lying down but on standing symptoms are increased. General health good.

Patient had had measles at 10 years fracture of elbow at 2 years operation for delayed ulnar palsy 5 years ago appendectomy 14 years ago.

General examination discloses essentially normal findings with teeth tonsils and sinuses negative. The abdomen is normal except for scar in the right lower quadrant and there is a scar over the left ulnar groove. Reflexes are normal. The lower extremities are equal in length.

Lateral alignment of the spine is good. Slight dorsal round back is present. Lumbar lordosis is moderately increased. Movements of the upper spine are free in all directions. Flexion extension and lateral bending are limited by muscle spasm and pain especially if passive flexion is attempted. Tenderness is marked when pressure is exerted over the spinous processes of the last lumbar and first sacral vertebra. No tenderness is elicited on compression of the iliac crests or the trochanters. Straight leg flexion causes pain in the lumbosacral region and behind the knee. No tenderness is present along the sciatic nerves.

X ray examination of the fifth lumbar vertebra shows a symmetrical sacralization of the transverse process which is very marked but not complete. Both sacro iliac joints are widened and the joint surfaces sclerosed.

Operation July 5 1928 consisted in trisacral fusion—fusion of fourth and fifth lumbar and first and second sacral vertebrae bilateral sacro iliac fusion. The immediate result was excellent. The time elapsed since operation is entirely too brief to judge the final outcome.

CASE 5. Mrs. E. S. aged 41 years mother of three children. Patient has had right sciatic pain for 10 years. Pain is intermittent in character its onset abrupt and sharp being in the posterior aspect of the right hip and radiating along the posterior thigh region and posterior lateral aspect of the leg. The pain becomes worse when she sits and she prefers to stand or lie down. When riding she found that she was more comfortable if she sat with her right foot under her. About 4 months ago severe pain began in the lumbosacral region. This was accompanied by a slipping sensation in her lower back. The sciatic pain became distinctly worse at this time and there were occasional radiations down the left sciatic region.

Patient has had no severe illnesses. Her upper teeth were extracted 6 years ago and she had tonsillectomy 7 years ago.

Examination shows a moderately obese woman in good general health. General examination is negative except for moderate amount of dental work. The sinuses were normal. The back shows moderate obliteration of lumbar lordosis. There is no lateral deviation of the spine. Motion is restricted in all directions at the lumbosacral juncture. Tenderness is marked over both sacro iliac joints as well as in the midline at the fifth lumbar vertebra. Straight leg flexion causes pain in both sacro iliac regions as well as at the lumbosacral juncture.

X ray examination shows that both sacro iliac joints are slightly widened and the bony surfaces are distinctly sclerosed. Small spurs are present at the lower margin of the left sacro iliac joint. The lateral articulations of the lumbosacral juncture are of the cervical type. On the right a large irregular osteophytic reaction involves the joint and extends laterally. There is partial ossification of the ilio lumbar ligaments. Lateral view shows a normal lumbosacral angle.

Operation May 1 1928. The fourth and fifth lumbar and first and second vertebrae were fused. Both sacro iliac joints were fused the technique described being used. The postoperative course was normal except for urinary retention which cleared after 6 days.

This series of five cases of trisacral fusion is too short and of too recent date to judge as to end results. The immediate results are very encouraging.

ing and justify the employment of this operation in a longer series. The heavy callus formation at the lumbosacral juncture shows the advantage of union of the iliac transplant. The fusion of the lumbosacral joint is much more difficult to demonstrate by means of the X-ray. Clinically fusion has occurred in all of this series.

SUMMARY

A new operative technique for the combined stabilization of the sacroiliac and lumbosacral joints is described. The immediate results in a series of 5 cases are such as to warrant the more extensive trial of this procedure as a means of relieving low back and sciatic pain.

No attempt has been made to discuss the symptoms or detailed etiology of low back or sciatic pain. The reader is referred to the vast volume of literature on this subject published during the past 20 years.

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THE RESULTS OF TREATMENT OF TUMORS OF BRANCHIOGENIC ORIGIN

BERNARD I. SCHRIENER, M.D., F.A.C.S., BUFFALO, NEW YORK
 Staff Physician, St. Hy. Hospital, Buffalo, N.Y.

A SURVEY of our 736 records shows that there occurred since 1914 eighteen cases of tumors which I believe were of branchiogenic origin. Two of these were benign and sixteen were epithelioma (squamous cell carcinoma) making the incidence of malignancy 82 per cent.

These sixteen cases were of importance in that a careful study of their records showed that they were of exceedingly rapid growth during which time some of them were suspected to be of an inflammatory nature and were dealt with by their physicians by incision to evacuate a supposed abscess. The age incidence of these malignant tumors is depicted in Table I. Fifteen of these cases occurred in males, one in a female. Two gave a positive blood Wassermann reaction. Hereditary history of cancer was obtained in two cases and in one case the wife had died many years before of cancer of the uterus. There was no history

of trauma. From their histories these patients complained of pain or stiffness in the neck, swelling which had existed from a few weeks up to one year. In two instances the patient records a swelling which grew rapidly, then subsided somewhat and was followed by another period of rapid growth. At the time of admission seven patients had ulcerating masses and three had brawny hard or indurated masses with areas which felt cystic. The tumor occurred on the right side of the neck twelve times, on the left side four times, occupying sites from the angle of the jaw to the clavicular insertion of the sternocleidomastoid muscle. The submaxillary region and the middle third of the sternocleidomastoid muscle seem to be the most common sites. Before admission these patients were subjected to operation in five instances to incision for the evacuation of pus on two occasions. Plasters, poultices, and X-ray treatment had been given in six cases.



Fig. 1. Case 1093. Died as the result of edema of the larynx.



Fig. 2. Case 9544 shows an ulcerating lesion which had been incised for abscess.

Ewing¹ in his text book *Neoplastic Disease* and Carp and Stout² in a recent and very comprehensive paper entitled *Branchial Anomalies and Neoplasms* call attention to the difficulty in diagnosis. I fully realize that the diagnosis of epithelioma of branchiogenic origin must be arrived at after careful consideration of the possibility of primary growths in the nasal cavity or sinuses pharynx and oral cavity larynx and upper end of the esophagus. In the study of the six cases both clinically and on four occasions at postmortem we were unable to find any primary growth in these regions. The microscopic examination of the tissue removed at the time of operation or of biopsy material was reported as epithelioma (squamous cell carcinoma) pearl formation being noted in a few sections. In cases which came to autopsy metastases were noted in the regional lymph nodes and mediastinal nodes on one occasion.

The two patients who had branchiogenic cysts are alive and well as the result of operation. Of the sixteen malignant cases in five the tumor mass was removed in two it had been incised by the family doctor for supposed abscess and in all the remaining cases biopsy was performed. Radiation therapy consisting of large radium packs or high voltage X ray proved only palliative in one case and of no avail in the others. The longest palliation was one year. No apparent clinical cure have been effected by any form of treatment in these cases.

B E J A L I I S J Ph d I h W
L C A S P d S L S B h l m l d
J L m A S R 7 l

TABLE I—AGE INCIDENCE OF MALIGNANT BRANCHIOGENIC TUMORS

| A | C |
|---------|---|
| 1 to 9 | |
| 3 to 39 | |
| 4 to 49 | |
| 5 to 9 | 9 |
| 6 to 9 | 5 |

Of the five cases in which radical operation had been done followed by radiation treatment all died in from 3 to 9 months after treatment unimproved.

The two patients subjected to incision for abscess and treated with high voltage X ray died within 4 months after treatment unimproved.

The nine patients in whom biopsy examinations only were made and who because of inoperability were treated with high voltage X ray or with large radium packs died within 1 to 3 months after treatment unimproved except one who was relieved somewhat for one year.

CONCLUSIONS

1 Branchiogenic epithelioma represents 0 per cent of the malignancy in our experience.

This disease occurs much more frequently in the male.

3 It occurs most commonly in and after the fifth decade.

4 Mistaken diagnosis for inflammatory lesion is common.

5 All forms of treatment whether surgery or radiation have been only palliative.

CONGENITAL VALVULAR OBSTRUCTION OF THE PROSTATIC URETHRA

HUGH H. YOUNG, M.D., F.R.C.S., F.A.C.S. AND ROBERT W. MCKAY, M.D., BALTIMORE, MARYLAND
F m th J m e B h B dy Ur l I l t t J h H pk H p t l

ALTHOUGH congenital valvular obstruction of the prostatic urethra was recognized 135 years ago it has received very little attention in the medical and surgical literature so that it seems timely that we bring together a complete study of the cases that we have had at this clinic.

The credit for first recognizing the condition is given by earlier writers on the subject to Conrad Johann Martin Langenbeck, who is supposed to have published in 1802 a drawing of posterior urethral valves in his monograph *Ueber ein einfaches und sicherer Methode des Steinschnittes*. Velpeu, 30 years later in 1832 in his surgical anatomy and Jarjavay in 1856 in his monograph on the urethra refer to this diagram of Langenbeck. Velpeau's allusion to the subject is as follows:

The verumontanum in prolonging itself backward to form the uvula vesicae sometimes expands and gives rise to two lateral folds which present in fact the appearance of two very thin valves. In passing forward toward the membranous portion the crest now and then presents a similar disposition. This does not appear to be a very rare occurrence for we have met with it three times and it is delineated by Langenbeck in his treatise on lithotomy published in 180. What Velpeu probably refers to is diagram V in this article. A longitudinal section of the urethra is shown and the valves are very vaguely outlined. They are not described. Velpeu does not give descriptions of the three cases mentioned. Jarjavay gives very excellent descriptions and anatomical diagrams of valves in the several portions of the urethra.

In 1840 Budd described an autopsy in which bilateral hydronephrosis, hydro ureters and a hypertrophied and dilated bladder were found. Examination of the urethra showed valvular obstruction which he described as being in the membranous urethra. He says:

The individual who is the subject of this paper was a sailor age 16 who entered the hospital in a state of unconsciousness and died a few days after his admission. When the abdomen was opened the kidneys were found to be very much dilated. They were not less than pouches containing about a pint of liquid apiece. The ureters were dilated to the size of one's thumb from the pelvis of kidney to their entrance into the bladder. The ureters were so folded at the junction with the bladder that no efflux up

the ureters occurred when pressure was made on the bladder. The bladder was dilated and had trabeculae similar to the endocardium.

There was found in the urethra attached to its roof a valve of mucous membrane analogous to the valves in veins or the semilunar valves of the heart immediately behind the bulb of the urethra. This valve formed during the patient's life an obstruction to urine flowing out of the bladder without presenting an obstruction to the passage of a catheter. Behind the valve the urethral canal appeared normal.

Budd in the discussion said that he thought the membrane congenital.

In 1840 Bednar described an autopsy on a premature stillbirth which showed two concave folds in the urethra which came off from the lower end of the verumontanum and were associated with dilatation of the bladder, bilateral hydronephrosis and renal atrophy. The valves were described as follows:

The verumontanum divided at its forward end into two folds of mucous membrane crescentic in shape and with their concavity directed toward the bladder. A probe could be passed from below through the valves. I resure on the bladder ballooned them out thus closing the lumen between. There was bilateral hydro ureter and bilateral hydronephrosis.

Goudard described similar cases in 1854.

In 1855 Picard described a case in a man 40 years of age who presented symptoms of difficulty of urination and uræmia with convulsions. Examination showed a markedly distended bladder and subsequently autopsy showed urethral valves springing from the verumontanum with bilateral hydronephrosis and hydro ureters. This is apparently the first case in which valves have been discovered in an adult.

The first illustration of the condition drawn from an actual specimen to be found in the literature is in a report of Tolmatschew who in 1870 described an autopsy in which he found two urethral valves springing from a point just below the verumontanum (Fig. 1).

Eigenbrot in 1891 reported a case of valvular obstruction of the vesical orifice but apparently the fold of mucous membrane was intravesical and not in the posterior urethra.

Poppert in 1891 described a case in a man 24 years of age who had had difficulty in urination since childhood. Urethrotomy showed an obstruc-

tion near the vesical orifice which was thought to be produced by a fold of the mucous membrane. A retention catheter was inserted but the patient died the following day. Autopsy showed a fold of mucous membrane coming from the vesical neck in the form of semilunar valves which caused obstruction bilateral hydronephrosis and hydro ureters. The case is illustrated. The valve measured 1.4 centimeter in diameter and its free surface was 1.5 centimeters in circumference. The internal phincter was dilated. He stated that undoubtedly the condition was congenital.

During the next 15 years personal cases were reported by sixteen separate observers all in infants under 5 years of age except one case that of a later in a boy 15 years old. In this case autopsy showed a diaphragmatic membrane below the verumontanum with bilateral hydronephrosis.

Up to this time all cases have been found at autopsy or accidentally at operation. A brief description of apparently the first case in which the condition was seen with a cystoscope follows:

Th p t t i m l d m t t d j h f l p k
l l t l l N m l m p l a n g l n n r v
l l t l l l t h f l l t d r y h o r l n
h t l t h t f l e h t r f p
l t l l m t l h n b l l a b l
l p t t l l b t l l r l p h y l l t
t h n g t C l t p d t l e d
f l a l t m t o l l h b l d
p t t t m t l h v t j e p d
l t g o b t t t d t p o t t Th
l l l n l v l t l l m t f t h u t
t l m l l v l t l l m t f t h u t
t h t y t h p l l d p m t d
t l t l t t a d t m t u m f l d e
l d t l m t n m l h n m l l
l h p p t t f t h m t m b f u t d
t f m t n n d t h f l d f t u e h h
p p t l t h d t h f d l t e l w l f
t h t t d t l f t h r u m o
t m n t h l a t v d t l d b s l l o g
t h t m t a l m n t t h p t o d d
m h m f d h f m r s y m p t m l g e l y
l p p e l l l d f r y t h t f h f o
m s y m p t m l d f f p m A t p v
l l l l l h d l l d b l d l h g h t
t r a t t m t d m t l h g h t
t l m l l a t m t l m r l y y
t l Th g l t p l g t h d l l t h
p l t t p l f t h k d t h m d t h v l
p h t l h d t n t l l f t d t h t e l
p h t d t d n d t t e t h t m e d p t o
l t h p r t t l t l k p g w h t d d f m
t h e l n t t h l f o f t r u m t m A
p d e p d t t h l d r f t m e t Th
m n t m b f u a d t h t y t d i g t o w d
t h b l d l m h l g f t h v t t d e d p
t a t t d t b f t h b l d f u b d g
t l l l t l t m l l m l f m t h f o f t h e
t l Th k t u d t h l l k t y l n b d
t l l t h f t h t m l p h u t f h
p l e d t t d l d l t e d O m t f t h e

m l of the p t e t h o l y l g h t f v d l a
t i o v l m t l l o r p e o f t h r a m o n t m
a n d o s l o n g m i d l n f t h u e t h a l f i o r a
f l y p r m l o n g t u d i n a l d g e t s e w h a
f o m l h f l o f t h u r t h f o r t o t r m l m t

This is apparently the first case in which the valves and obstruction produced by them have been recognized cystoscopically.

We quote here a description of the first successful operation from Young's *Practice of Urology*:

T t t t c h h t l l f t h e p o t
t t t h u l b y p t o a s t h o f p t t
w h m t t h s l l a g u t o 3 I f a
t h o l d d h l f o m b r t h u s s e c d f m g t d f f
l t y a f f e q n v f t n l x a m n t l e l e l a
s l y d t d e d l l d e r A t t m p t t p s t h t s l
u n d u u c f l o g t o a l t u t d l
t h t r m l p h e t a d t h o h t l t t h p
t t f A h l f o m a s d l y p e l t t h l l d
d e t h h a s e t l t h t p l e d l g
a m t o f d l u t o c l t h y Th
p l t h l h l y t f t l f t t d o
l l f h d l y 3 o r n t f o g l i A t h n m
y t o m h d l u t t o f t h l o t t e t h d
d g o l b t t m t h e n t e n o p a t f t h p t t
u t h r m d e O c t l 3 o r 3 O p a t A u g
p p l y t t m y T l l o f c a f u d b e
d t l l d j t b e y n l t t h p r t a t u t h r a
m l l t l l l i k e l a t r u t h h l
t d t d d l f o m t h f t t h f t
l l y d b y a l m p p l l d t t h l l d d d
t v l t l l t o a t y A f t t h t u m t l l
l y l p d f m l m t n t t h b l d d l h
l e l d l m j e l y d t y d l h p t n t m l
e l l t c r

This case was reported by Young to the Johns Hopkins Hospital Medical Society in November 1913 and was apparently the first clinical recognition and operative cure of congenital valve of the prostatic urethra.

The second operation on congenital valves was performed one month later.

T h e t t t w a r m o t h l d d h l l a d d f l t n d
p f l u a t o n f r m t h w t h c a o l m l d d
t t i o o f t h b l d d m t m s g g f h w t t
d g A t e t c t h t w s h a n s l p d n d 500
u l e t m t f d l h t n d P h t l l
t e s t s g o o d 7 p r a t f t h t h t h A d g n
m l e f r m t h o b t u r t o n t e e l t h p t e
t t h w h t t e m p t m d t o p t h t
l o d A t p r t A g t h p t t f c
g f u d t b d l t e d a d w h o d p d
n t h e u t h m e m b r a e u l d b e s o n t h
n d f t h d Th l d b e p l a t e d t h h n g
d w s r e n u z e d a s t h u n d p h A l g p b
f i n l y p a s d f o m t h u t t h b l d d a d a
p n n l i c n w s t h e n m d t h b u l b u e t h r a
d i f m t h e t r a m t y p e d w h c h r u p t t
t h a l e s d p d c d f p a g w a y t h o g h t
t h t t h b l d f l g i n t r u m e n t

It seems evident now that the perineal incision was entirely unnecessary. A good result was obtained however.

The next case in which valves were recognized by cystoscopy and urethroscopy and confirmed by cystogram which showed for the first time the greatly dilated ureters and pelvis which are characteristic of this condition was that of a boy admitted to the Brady Urological Institute May 1915

Patient B U I 439 aged 12 years complained of frequency and difficulty of urination since birth. Large sausage like masses could be felt on each side of midline and beneath the costal margin on either side large soft structures apparently kidneys were palpable right considerably larger than the left. It was impossible to pass the ordinary catheters and sounds but a urethral catheter was introduced without much difficulty and withdrew 60 cubic centimeters of cloudy urine. After the bladder was washed clean a child's cystoscope about No 12½ calibre was introduced without difficulty. Both ureteral orifices were found markedly dilated and the bladder was trabeculated. The prostatic orifice was found to be dilated. A cystogram was obtained with thorium nitrate 10 per cent which showed marked dilatation of the upper part of the prostatic urethra bladder both ureters and kidney pelvis as shown in Figures 3 and 4. On June 2 1913 suprapubic cystotomy was carried out by Young and dilatation of the vesical sphincter was discovered. The index finger could be introduced through the internal sphincter and passed down the urethra about 1 centimeter where it met with an obstructive band across the urethra. A small sound could not be passed through the urethra into the bladder unless the beak was made to hug the posterior wall of the urethra for it met there an obstruction evidently a band or valve which could be felt from above. By means of the cystoscopic rongeur which was passed through the urinary meatus this band was cut and excised. The operation was repeated three times. The valve was quite firm fibrous and a moderate amount of force was necessary in order to excise it with the rongeur. Examination of patient with finger through suprapubic wound then showed that the urethra was widely dilated and that the finger could be introduced as far as the triangular ligament. A drainage tube was placed in the bladder suprapubically the wound closed and an excellent result obtained. He was well for 11 years. He then entered the hospital with perinephric abscess pulmonary signs myocardial failure and death. Drawing of autopsy is shown in Figure 5.

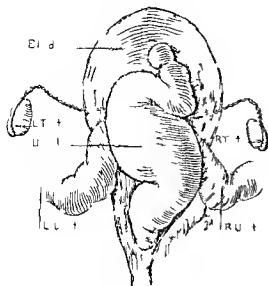
The first case to be recognized at autopsy in America is that of Knox and Sprunt in a report from the Medical and Pathological Departments of Johns Hopkins Hospital.

The patient a boy aged 5 years had suffered with frequency of micturition since birth. On examination he was found to be sparely nourished with pendulous distended abdomen. On palpation in the left lumbar region there was made out a soft movable lobulated mass from the anterior superior spine to the costal margin and about midway between the umbilicus and lateral portion of the abdomen. This mass could be readily brought between the fingers in manual palpation its borders were rounded. In the right flank a similar mass was made out emerging from the lower border of the liver. A third rounded mass was detected in the midline extending from the symphysis pubis to the level of the umbilicus suggesting an enlarged urinary bladder. Urine was turbid and its specific gravity was 1002. The presence of the lobulated tumors above described in the flanks made a diagnosis of congenital cystic

kidneys possible. He was admitted to Johns Hopkins Hospital January 1902 very pale and ill. On palpation a distended bladder and enlarged kidneys on both sides were made out. No urological examination was attempted in the Pediatric Department and patient died at the end of weeks. Autopsy findings are shown in the excellent drawing Figure 6. A probe passed through the vesical orifice met obstruction in the lower prostatic portion similarly when the urethra was sounded through the external meatus obstruction was encountered in the same region. The roof of the urethra was divided and the posterior urethra was described as follows: Through the wide internal meatus the bladder becomes continuous with the greatly dilated and thick walled prostatic urethra which forms an oval sac with the distal blind extremity 2.5 centimeters from the internal meatus. The floor of this pouch shows several prominent folds near the midline which end below in an unusually prominent verumontanum which reaches three fifths of the distance from the internal meatus to the blind end of the sac. The opening of the vagina masculina is conspicuous shaped like a crescent with the convexity directed upward. Numerous orifices of the prostatic ducts are observed on each side of the verumontanum but those of the ejaculatory ducts are not seen. Immediately below the verumontanum the ridge of which it forms a part divides into two prominent diverging folds which soon fuse with the anterior wall of the urethra instead of fading out gradually on the posterior wall of the urethra as usual. Just below the verumontanum between the diverging folds there is a small equilateral triangular opening the sides of which measure about 3 millimeters. A probe passed through from the anterior urethra presents in this opening and abuts against the hypertrophied verumontanum. This is the only communication between the anterior and posterior portions of the urethra.

Microscopic description. Sections were prepared from the lower end of the prostatic sac through the folds immediately below the verumontanum and through the proximal end of the same structure. The blind end of the prostatic urethra is clothed with stratified pavement epithelium similar to that of the esophagus. The fold below the verumontanum are covered with the same type of epithelium but that of the anterior urethra is so badly desquamated that its nature cannot be definitely determined. Over the verumontanum and the rest of the prostatic urethra the usual type of epithelium is present. The subepithelial tissues everywhere consist of a very dense fibrous tissue with a few elastic elements. Small clusters of mononuclear cells may be found occasionally beneath the epithelium. The vagina masculina is not prominent. Indeed it is less conspicuous than is often the case.

The third American report was made by Lowry in 1914. An autopsy upon an infant 3 months old showed valvular obstruction at the lower end of the verumontanum bilateral hydronephrosis and hydro ureters. In 1919 Young Frontz and Baldwin presented the fourth American paper in which they reported 12 cases in 8 of which operation had been successfully carried out. The four cases in which operation was not performed had died. In the literature at that time they found 17 definite cases all of which had been found at autopsy. In none of them had diagnosis been made or operation carried out so that the true condition was recognized only at autopsy.



tal valves of the prostatic urethra in which he carried out fulguration through a cysto-urethroscope. One of these patients was only five years of age the other seventeen. The method was new but apparently entirely successful.

The next important clinical paper was that of Hunman and Kutzman who in 1925 gave a very full and comprehensive resume of the literature. They reported 6 cases, 3 in children between 2 and 4 years of age and 3 in adults. In 4 cases the diagnosis was made by cysto urethroscopic examination. In 2 by means of cystograms. The treatment employed was suprapubic cystotomy with destruction of the valves in 4 cases and urethrosopic fulguration in 2 cases. The results were apparently satisfactory in all cases.

Another case in which the valve was recognized cystoscopically, was that of Scholz who subsequently destroyed the congenital obstruction by means of passage of sounds. (See Table III)

Excluding our reports we have found 41 cases in the literature, in 12 of which operation on the valves was carried out. We report herewith 21 cases from the Brady Urological Institute making a total of 63 cases which are tabulated and studied in detail.

In making a critical analysis of the cases mentioned in the literature we find the following case of valvular obstruction that we have not counted as a true posterior urethral valve. Ei enbrod 1901 operated upon an obstructing valve which was intravesical and not in the posterior urethra. Posner in 1907 describes a case that was probably urethral stricture and not true valve formation. Jordan 1913 also reported a case that was probably urethral stricture and not true valve formation. Iverson in 1914 reported a case of a man 85 years of age who had a very large prostatic hypertrophy. False passages were produced in the prostatic urethra from instrumentation and the structure which he saw at suprapubic operation from the description was probably an artifact from instrumentation and not a true posterior urethral valve. We have included these 4 cases in the tabulation but subtract them from the total number of 45 tabulated leaving 41 true cases in the literature.

The 17 cases shown in Table I comprise the first series of congenital valves of the posterior urethra reported from the Brady Urological Institute. Of the 17 cases 8 were operated upon, 6 of the 8 operated upon were cured or markedly improved. In 4 cases in the series operation was not done, all of these with one exception died soon after admission to the hospital. They were in *extremis* on admission. Of the 6 patients operated upon and

In 1916 Young carried out his punch operation in case of congenital valves in adults respectively 6 and 4 years of age with complete relief of obstruction in both cases.

In 1902 a child 7 years of age with a typical case of congenital valves of the posterior urethra came to Brady Urological Institute and for this case Young constructed a specially small baby punch.

A l g m u t f d f t dr d b v t e l
 t t t t p l t l e t t sh ed m p o s n l
 f t t C y t t v then a d t f y m s f
 h h l y t p e d p e l l m l e i h p Th
 t h p e b l t p e l l y l e t t k h b t w e
 t h t l t l l t p l p h h N f m d
 f t l e (f l t l h h t h e l y
 m d g b t l h t r m l a t e t o d ced
 t o g l t e c t a t l t e n d f the
 b l d l T l n t h t t b t t a t h d n d
 n d e g e t o p l h l m n t h t l l d
 t a l u t l t h l h t t h f a t Th
 t l d d l d t h n d p l h t h b d t
 t e d k t e l a l t l l t t e t e i d
 f t l t r u m t Th t t t h t e
 t l i t h e l t f m d p f t
 h h l t m t l l b p d t h t l a d d
 t e

This method was very satisfactory in the case employed and it seemed quite feasible to prepare minute baby punches which could be used for infants at birth.

In 1921 Randall reported two cases of congenital

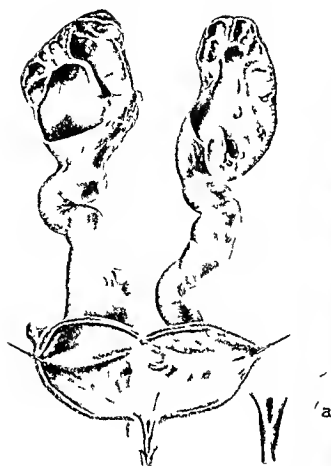


Fig. 1. First case recognized by optical instrument in a living subject shows the remains of congenital obstruction. Type: dilated bladder, marked hydronephrosis, bilateral hydronephrosis. Valves ruptured instrumentally. In this case the long examining barrel used with lithotrite was passed up the right ureter all the way to the pelvis of the kidney and a view of the pelvis of the kidney, as in this manner obtained. This is also probably the first patient in which the pelvis of the kidney was cystoscoped during life. In Fig. 2 shows enlarged view of condition present.

reported as leaving the hospital well we have traced the following:

Case returned to the hospital after 11 years report that he had been quite well since urination normal. At 2 years began to have intercourse regularly and ejaculation was normal. He contracted gonorrhea 1 month previous to entering hospital and the infection spread into the bladder and upper urinary tract. At time of admission to the hospital he had a temperature of 101 degrees. His urine was loaded with pus and intracellular diplococci. He also had a very severe throat infection and developed a perineal abscess which was aspirated and showed streptococcus viridans in culture. His course in the hospital steadily downhill. He developed pulmonary symptoms followed by myocardial failure and died. Autopsy showed cystitis, bilateral pyonephrosis, old Pott's disease of the spine, amyloid spleen and a large perineal abscess cultures from which he died of streptococcus viridans. This is the case illustrated in Figures 3 and 5.

Case 6 has been ill for 11 years since for the fact that he has had bilateral nephrolithiasis for which condition he has been operated upon successfully elsewhere.



Fig. 3. B. U. I. No. 4395. Cystogram showing distended bladder, dilated prostatic urethra, bilateral hydronephrosis and hydro ureter. Suprapubic cystostomy with destruction of valves.

All attempts to gain contact with the other four cases have proved futile.

Since this report in 1910 we have seen in the Brady Urological Clinic 9 additional cases of congenital valves of the posterior urethra. A detailed description of each case follows:

CASE 1. Congenital valves. Punch operation with baby punch. Case followed five years.

B. U. I. 855. B. G. aged 8 years was admitted to the hospital February 24, 1920, complaining of bladder and stomach trouble. The patient, as one of eight children, the rest of whom were living and well. He was a full term child of a normal labor and was breast fed. The mother had noticed that the child passed urine very frequently. Apparently at night he urinated every few minutes wetting the bed. She noted also that sometimes during the day he wet his clothes and complained of severe dysuria at times. It was noted when the child was quite young that he had a large distended abdomen. There had been no history of complete retention or periods of inability to urinate. His mother had noticed that the child had always had a bad cold and had been rather slow. He had never gained in weight in proportion to his age. The condition had been diagnosed by a doctor as enuresis.

Physical examination showed hemoglobin 88 per cent, white blood cells 11,000, red blood cells 4,500,000. Examination showed a well developed boy except for the protuberant abdomen. The teeth were in very poor condition.

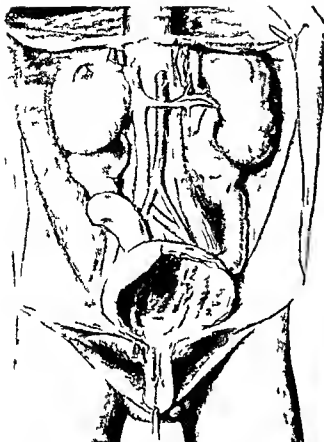


Fig 6 Case of Knorr and Sprunt showing typical urethral valve of Type 1 with the usual back pressure effects produced

the fenestra of the instrument. By the sliding home of the cutting obturator this entrapped mucous membrane was divided and when removed with the instrument it was found to consist of a portion of the right valve and a small piece of the verumontanum. The strip of mucous membrane removed was approximately 1 centimeter long and about 4 millimeters wide. No catheter was placed in the bladder. No other cut was made.

Postoperative notes. On returning to the ward the patient voided some urine with small amount of blood. Two days later he was able to hold his urine 3 hours and 50 minutes voided four times during the day and held his urine from 8 p.m. to 6 a.m. The size and force of the stream were very good, no hesitation, no straining, bladder not percussible. On discharge 5 days after operation the bladder was not palpable above the symphysis. He was voided in three to four times during the day and holding his urine

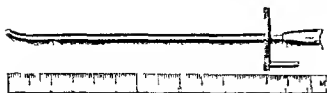


Fig 7 Baby punch in instrument specially designed to remove valves of the posterior urethra in children



Fig 8 Case 3 B.U.I. No. 9023. Greatly dilated bladder and huge prostatic urethra treated by suprapubic cystostomy, rupture of valve with sound and later punch operation.



Fig 9 Case 5 B.U.I. No. 47. Cystogram shows large hourglass bladder with trabeculation. Arrow points to suggestion of dilated prostatic urethra.



Fig 1 C 6 B U I N 354 Cyt amsh s
l k mm t 11111 th > d t t d t t f
r t th f m l l l t r u t C ed by
h p t D t d l t d k d y l d b
l t t t g t t N y P b b l d t
t l k k q t l l f t d m p e o f d
t l l b l d



Fig Case 8 B U I N 6633 Cyt m lo
gm k d d l t d b l d d e n s n g h h a b p l D f n t
f l a t o r e d c p o d g t o p o t t t h r a
V l p o h r u p t u d i y p g f t r u m t



Fig C o B U I N C Cyst m t k
4 d y f t t f t h t h s r m l y d
t d e d b l d b l a t r a l h y d o t d h y d p h
t h g t k k d t t t v f t h t r s l t
t t t o m p t h y t m w t h F g u 3
h h t k f t p t

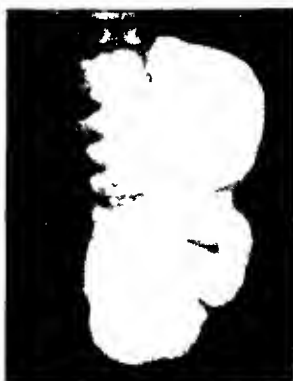


Fig 3 C o B U I N 6577 Cyt g m t k e
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d d p p n r y t t E n w t h g t d t t
o d d l d b f e d p t h n i g h t s d

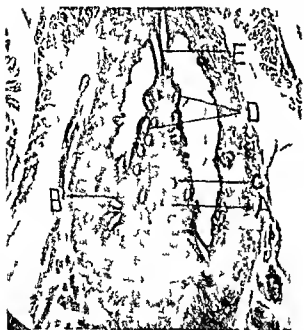


Fig. 14 Cross section of urethra in embryo showing three fibrous bands extending from verumontanum to roof of posterior urethra illustrating formation of valves (Watson)

all night had no straining and no hæmaturia. The urine on discharge was clear and showed no infection.

A follow up of the child showed that 5 years later he was in school apparently well. He was voiding twice at night about a pint at a time. He could not be persuaded to return to the clinic for further examination.

CASE 2 Congenital valves of iris type treated by suprapubic cystostomy and punch operation. Excellent result.

B. U. I. 8728 R. V. E. 7 years old. Patient was admitted to the clinic with complaint of unable to hold his urine. General health in the past has been excellent. He has had the usual childhood diseases. Circumcision was done because of enuresis at age of 3. He gives history of incontinence, hesitancy, dribbling, no hæmaturia, renal colic or passage of calculi, some dysuria. Nightly incontinence, diminution in size of stream.

Physical examination showed a fairly well nourished boy of 7 years. Heart and lungs were normal. The abdomen was negative. The left testicle was undescended, the right testicle normal. Phthalein appearance time 7 minutes, 40 per cent first hour, 10 per cent second hour—total 50 per cent. Examination (Fronitz) A coude catheter passed with ease, residual urine 200 cubic centimeters. Cystogram was taken which showed a rather unusual bladder outline. The bladder was roughly oval, long diameter not in midline but asymmetrical, marked dilatation of the vesical orifice forming a funnel shaped end to the cystogram. Cystoscopy showed marked trabeculae, cellulæ, hypertrophy of the trigone and ureteral ridges. When the child's cystoscope was withdrawn into the posterior urethra there appeared to be a large verumontanum on either side of which folds of mucous membrane connected with the lateral walls of the prostatic urethra representing the remains of the ruptured valves were seen.

April 30, 1900 operation was done by Fronitz, nitrous oxide ether anesthesia being used. Through a suprapubic cystostomy with punch the congenital urethral valve was removed. The bladder was exposed in the usual manner and opened. Examination of the vesical orifice showed

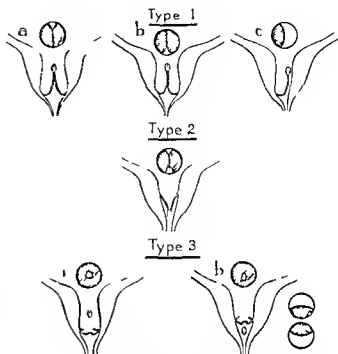


Fig. 15 A diagram showing the three types of congenital valves of the posterior urethra. Type 1 a Two bifurcated valves springing from distal portion of verumontanum b Two fused valves in same position c A unilateral valve in same position. Type 2 A bifurcated valve extending from proximal portion of verumontanum to lateral sides of prostatic urethra and roof. Type 3 a Iris valve below verumontanum b Iris valve above verumontanum. The shaded circles represent the cystoscopic field seen in the region of valve. The internal pinclips and the prostatic urethra are shown to be dilated and the region of the membranous urethra is indicated.

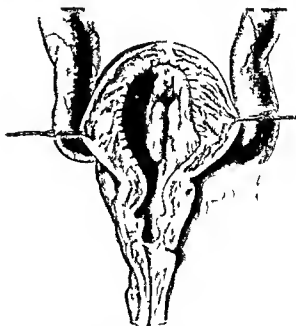


Fig. 16 Sketch of one of former cases showing the crescentic type of valve Type 3 and hypertrophied bladder and dilated ureters produced by the obstruction.



Fig. 18. Cystogram showing large oval distended bladder. Arrows point to dilated prostatic urethra and vesical orifice.



Fig. 19. Cystogram shows irregular dilated bladder with trabeculation. No ureteral reflux. Arrow points to marked relaxed vesical orifice.

Examination of heart and lung showed a lesion in apex of the left lung. The abdomen was negative except that bladder was palpable above the suprapubic region and was distinctly distended. Great obstruction was encountered in the prostatic urethra to the passage of instrument finally, however, a very small catheter was passed into the bladder and 550 cubic centimeters of residual urine was found. The urine was cloudy, acid, specific gravity 1.008, albumin —, pus —, bacillary infection. Hemoglobin was 83 per cent, blood urea 0.60 grams per liter, phthalein test in 4 hours. A cystogram was taken and showed a large dilated bladder with great dilatation of the posterior urethra (Fig. 8).

August 30, 1920, operation was done by Geraghty, nitrous oxide gas anesthesia being used. Through a suprapubic cystotomy dilatation of the internal sphincter was done and congenital valve ruptured by means of large bougies passed retrograde through the prostatic urethra. The bladder was opened and urine was found to be under great pressure. A finger was introduced with difficulty into the vesical orifice and the internal sphincter was found intact. After digital dilatation of the internal sphincter the finger was passed into the prostatic urethra which was found to be enormously dilated. A bougie was passed retrograde through the internal sphincter as far as the lull.

Severalsound were passed in order to insure breaking up of the masses. A drainage tube was sewed into the bladder suprapubically and the rest of the wound was closed.



Fig. 20. Cystogram showing marked cellules and a very irregular bladder with a greatly dilated prostatic orifice.

posterior urethra were excised two large pieces of valve being removed. Five cuts were made. The first cut was directed posteriorly the valve caught in fenestra and the cutting tube pushed home. A little mucous membrane was found in the instrument. A second cut was made again posteriorly then one slightly to the right and one to the left. The instrument was then turned anteriorly and slightly to the left and a considerable amount of tissue was removed when the knife was pushed home. Altogether five cuts were made but only two succeeded in excising much tissue. Following this a No. 22 sound passed into the bladder with ease. A No. 16 catheter was left in the bladder.

Postoperative notes: Patient was discharged 10 days after operation voiding urine with good stream and passing as much as 60 cubic centimeters at one time. When his attention was directed to his bladder he was able to retain urine. At other times when attention waned he wet clothing and bed. His bladder capacity on forced distention was only 60 cubic centimeters. Before he left the hospital a No. 22 sound could be passed into bladder without difficulty. He was discharged from the hospital with instructions to retain urine as long as possible in the hope of thus dilating the contracted bladder. The child was poorly trained but when he made conscious effort he could retain urine for 2 or 3 hours. It seems probable that too many cuts were made thus producing incontinence. Two years later the child was reported as passing 8 ounce of urine at a time but still refused to make conscious effort to hold his urine and further follow up of child was unsuccessful.

CASE 5 Congenital valves Incontinence Valves ruptured by sound before admission Streptococcus infection pyonephrosis pyelitis death on operation

B. U. I. 12427 H. R. H. 5 years old was admitted June 24, 1924 with complaint of frequency and hematuria. There had always been some frequency and nocturia with nocturnal incontinence for one year. Hematuria appeared 1 week before admission.

Physical examination disclosed a poorly developed undernourished boy with tremor of fingers slight cyanosis rhinitis and cardiac enlargement. Pulse 90 respirations 3 blood pressure 30-74 white blood cells 8000 red blood cells 4,000,000 hemoglobin 55 per cent. A diagnosis of chronic rheumatic endocarditis and mitral insufficiency had been made. Bladder was per usual above the symphysis. Both kidneys were palpable. There was slight tenderness in both flanks. Rectal examination disclosed prostate normal in size shape and consistence. Patient was cystoscoped and 160 cubic centimeters of residual urine was found. The bladder capacity was 35 cubic centimeters. The bladder showed trabeculation no ulcers no diverticula. The trigone was slightly hypertrophied. A study of the prostatic orifice showed an internal sphincter so greatly dilated that the cystoscope could be pulled out into the posterior urethra and the verumontanum seen. As one drew the cystoscope out to the region of the verumontanum floating tags of mucous membrane were seen projecting from the lateral walls of the posterior urethra. These were assumed to be ruptured valves. A cystogram showed a dilatation of the vesical sphincter a large hour glass bladder with some trabeculation (Fig. 9).

Urinalysis disclosed cloudy acid urine specific gravity 1.024 albumin 3 plus occasional casts pus 2 plus culture of pus showed bacilli and cocci. Urine taken at admission appearance time 12 minutes 45 per cent 1 hour. After admission patient became quite sick. He had a fluctuating temperature up to 103 degrees. Pulse went as high as 130 hemoglobin dropped to 42 per cent. Blood culture was negative. Type of impetigo with herpetic vesicle from which streptococci were cultured developed. He was given a blood transfusion and this was followed by

a marked reaction with considerable drop in blood pressure and acute dilatation of the stomach. The non protein nitrogen rose to 200 milligrams per 100 cubic centimeters. Temperature rose and remained around 103. Patient died July 7th. Autopsy (No. 8131 J. H. H.) showed congenital valves of posterior urethra dilatation of the bladder cystitis urethritis bilateral pyelonephritis bilateral hydro-nephrosis with hydro ureter double left ureter with double kidney dilatation of stomach hyperemia of intestines enlarged heart.

The fatal ending in this case should be taken as a warning not to rupture the congenital valves by the passage of sounds without previous preparatory treatment directed against the renal impurment and residual urine.

CASE 6 Congenital valves of the prostatic urethra obstruction but no incontinence kidneys ureters and bladder markedly dilated punch operation cured 101 loved 18 months Well

B. U. I. 15354 P. A. aged 11 years admitted to hospital October 3, 1926. Patient has had difficulty of miction since birth. Shortly after birth the abdomen was discovered to be much enlarged. This continued up to the time of admission. There was also a history of occasional headaches and the usual diseases of childhood but no persistent incontinence or impaired health. The present illness began with vomiting months before admission which was followed by nausea and frequent droppings. Examination by patient's physician revealed bilateral tumors in the kidney region and a diagnosis of congenital polycystic kidney was made. Two weeks before admission the non protein nitrogen was 98 milligrams per 100 cubic centimeters. On admission examination revealed a distended abdomen chronic nausea occasional vomiting difficulty of miction but no incontinence. The face was edematous pulse 90 chest normal both kidneys enlarged and palpable. On three fingerbreadth below the costal margin. The dilated ureters were palpable on each side of the median line from the kidneys to the bladder. On rectal examination the anal sphincter was found to be normal the prostate underdeveloped the base of the distended bladder greatly dilated and the ureters palpable by rectum. The bladder was greatly dilated. On October 29th a No. 16 sound catheter was passed with ease until the prostatic portion of the urethra was reached. It then encountered an impassable obstruction. After much manipulation a No. 7 urethral catheter passed into the bladder. The urine was allowed to escape gradually over a period of 3 days at the end of which time the palpable distended bladder ureters and kidneys had disappeared. The urine was clear acid specific gravity 1.006 albumin plus microscopic examination negative. Blood creatinine was 12 milligrams per 100 cubic centimeters non protein nitrogen was 160 milligrams carbon dioxide 77 per cent. There was no excretion of phthalein in 3 hours. Three days later the blood urea dropped from 160 to 110 milligrams and the phthalein rose to 16 per cent in 2 hours. During the next 10 days the bladder was drained continuously with a urethral catheter and during this period the blood urea dropped to 37 milligrams and the phthalein increased to 16 per cent in 3 hours. The patient improved immensely in general health and was considered sufficiently well for operation. A cystogram was taken 10 days after urethral instrumentation. As seen in Figure 10 there was a greatly distended bladder which extended upward to the brim of the pelvis on the right. There was a conical process extending 1 cm from the bladder down into the posterior urethra to the

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t l m g Th l l d d t d e d a c l g h f
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t a e s t e d the p t t th f t r m e m n i p f
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h l 3 m l g m p o o c u h c e t m e t e s Th
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l Th d e c o m p l e wa m p l t d th n 4 h r s

f t e r w h c l f e d r n a g e w a s c n t i d t h r u g c t h t e
f r r d y f g h t d y a f t e the n s t i t u t i o n o f the a t h t
d a g p h t a l n h a d n e n t 5 p e r c e n t a d t h c h i l d
w m p r o e d b t f e w d y s l t e r b e g a n t o g t p o r
f y w o e The n p r o t e n u t g e r o s t 37 m l l
g m s p e r c o o b c c t i m e t t h n u s e o m t
d o w s s a d u x e m a c o t e d P t t i f i n l y d d
r d y a f t th th t e i z a t n

This patient was in a deperate condition on admission with no phthalein output and a non-protein nitrogen of 113. Had decompression been maintained longer than 24 hours it is possible that the patient would have done better. However the condition was almost hopeless from the start.

CASE 8 Co g t l l e of the p t t c th m d e t o b s t r u c t . Good health a d l f c s m t e d C d h y t r u m e t r u p t e o f l s

B U I 6633 g d 7 y a s d m t t e d to h o s p i t a l
O c t b e 4 9 m p l n h f d y n d p y u l l
t o v o f i n g n t i d e f e u y o f a t o n h t n d
d a y Th p t i e n t h d e n t l y h d b r g d p a
t o y e a h e h d h i l l s d e f e r a o c t e d
w t h l d y u n O n d m i o u n n a t o w f e e b t
p n f l n d s t e m g o o d The e a s n h e t a t o
The p l t e d the d p u e t l d r a d a t d t o t h
e d f t h e p e T l v a h t o r y o f h e m t

U t n f q l y t l t m t t e t m p n e d t h
l l t o p p a g t h h a d e t f p n a d t h h e
t l p d p n a d t h e e a s p a g e o f n Th
p n t h g o o f e t h e r h d y t t h b l d
p f q u e n t l y d e d t o t h g n o t o f the m b i v
Th s a h s t o y f d o m t g l a g a

S e t d y b f e a d m h w y t o p d l e
h s e d a d l t y f b o t h t e l n i a d t s
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p l e g a t l y d l t e d E a m t d l d t h h t
m l d b l m e g t e N b d m n a l m a s
r m a d t The w l u d y a d d s p e c i f g r y
o o f b m p l u p s p l u s c o d b a l l The n
p t e t o g n w 63 m l g m p o o b t
m e t r s c t n e 6 m l g m p i c b c t m e t
l m p e r a t e 99 6 d g e p l e o h a m o l b 84
p r e t w h t b l o d c l l 500 A m l l r u l b e t h t
c o l d b p s d w i t h o o b s t r u t a s c o t e d
3 b e n t i m t r s d l r e w a t h d w

A c y s t o g m w s t a k e n w t h 5 p c e t o d m o d d
(200 b c t m t e r s) f i g u r e r e a l m l e d y
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97 c y t p y w d e b y l g A h i l l s y t p
n t e d w i t h e T r i g n e s n t h y p t p h d t l
d e o t n l d B t h t l n f n r e

m k d l y d t e d The b l d l t t b l d t Th
p t a t r h d a t l W h e t h t r u m t
d n t t o t l t h t h t p o f m o m m
b n e w h c h t t a c h d t the w l l o f the t h l
h g f t h l u m v b l o e a h d p b b l y
l e s f t h r u m t a n u m h h a d b e n r u p t d b y
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t t h f o f t h u e t h p h a l y p t n o f t h l
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cent in 4 hours after appearance. Subsequent examination showed a similar high output. The non protein nitrogen varied from 40 to 48 milligrams per liter. Treatment consisted of passing sounds at intervals of from 3 to 4 days with continuous drainage of bladder with an infusing catheter followed by an irrigator passage of sound up to No. 61 at intervals of from 3 to 4 days. This was followed by a rapid improvement in micturition. On discharge from the hospital the patient was able to void in a good stream without hesitation. Control was good and there was no incontinence.

CASE 9. Constrictor valves of the prostatic urethra and obstruction with great dilatation of kidneys and ureters impaired renal function. Operation: one valve excised, obstruction removed, dilatation of one ureter and kidney.

J. W. B. U. I. 163, aged 45 years, admitted to the net line home of the Johns Hopkins Hospital September 14, 1922, complaining of large stomach pain on urination and frequent vomiting in childhood. The patient had not gained in weight, was generally constipated, had numerous respiratory complications and bad health since infancy. Stream was very difficult to start, was accompanied by severe cramping and in the evening. On one occasion he had a few drops of blood at the end of micturition. Examination (May 1923) showed the bladder was greatly enlarged, the suprapubic region and both flanks were free of fluid was demonstrated in the abdomen. The bladder was dilated and palpable up to the umbilicus. A cystocele, a sausage shaped mass, vesicalic neck, the prostatic dilated ureter. Both kidneys were enlarged and palpable three fingers breadth above the umbilicus. Percussion over the bladder caused a dull sound and also produced much pain. The genitals were normal. On re-examination the prostate was normal. The base of bladder was palpable. The ureters were not made out. The patient was able to pass only 50 cubic centimeters of urine at first voiding. Two minutes later he voided 60 cubic centimeters more and again after a few minutes a like amount. A catheter met with definite obstruction in the prostatic urethra. After considerable manipulation a No. 7 olive tipped urethral catheter was passed into the bladder and fluid flowed to escape slowly. The blood urea on admission was 0.44 gram per liter. Lithalmin appeared in 40 minutes but there was no elimination during the first and second half hours. There was 4 per cent at the end of the third half hour, fourth half hour 8 per cent, at 40 minutes 10 per cent, total 30 per cent in the 2 hours after appearance. Urine was acid specific gravity 1006 albumin plus pus plus lactipresent. Four days after the insertion of a urethral catheter a cystogram was taken as shown in Figure 1. There was dilatation of the bladder, both ureters and kidney pelvis with great tortuosity of the dilated ureter. No funnel shaped projection into the prostatic urethra was seen (cystoscopy was done (McClay). A No. 7 child's cystoscope passed easily. The bladder was found to be dilated the ureteral orifice greatly dilated and the trigone hypertrophied. No diverticula were seen. The prostatic orifice was greatly dilated. Drawing the cystoscope into the prostatic urethra and turning to one side a typical congenital valve of Type I was seen on the opposite side. The valve extended from the inferior portion of the ventricle in an outward to the lateral walls of the bladder and down along the roof. Near the apex of the prostate valve was able to see the point of fusion of the two valves. On September 10 a punch operation was performed by Young and McClay. No air was introduced. The index finger was introduced into the bladder, turned to the left in order cutting the valve with a needle followed by escape of fluid. The instrument was then

drawn out until arrested evidently by a left valve leaflet. The inner cutting tube was rapidly pushed home exciting a leaflet which when spread out measured 3 millimeters in diameter. It was thin and membranous in character. The patient was removed immediately from the table and voided 150 cubic centimeters of urine freely in a large stream. After waiting 5 minutes 100 cubic centimeters more urine was voided, probably due to the filling of the bladder by the overdistended ureters and kidneys. A second cystogram taken 11 days after the operation showed no reflux into the right ureter. The left ureter and kidney pelvis were still greatly dilated. Since then repeated cystograms have been taken on several occasions and continued to show no reflux into the right side but persistent distention of the left ureter and kidney pelvis as shown in Figure 13. No indwelling catheter was employed after the operation. Micturition as normal. The urine was cloudy with pus and bacteria present. The lithalmin output increased during the first half hour from 10 to 2 per cent. The blood urea rose from 40 to 75 milligrams per liter. The patient was discharged from the hospital 25 days after admission in excellent condition voiding naturally with no hesitation and no incontinence. He has been followed practically 7 months. He has improved greatly in health and strength. His weight has increased 4 pounds. Micturition is normal but his urine is still cloudy.

Although the urinary obstruction has been completely relieved by the removal of one valve with the punch and although reflux into one ureter has ceased, reflux into the other kidney still persists and shows great distention of the ureter and kidney pelvis. However there has been marked improvement in health gain in weight and activity of the child.

Of the 9 cases reported in Table II seen in the Brady Urological Institute since 1919 the ages of the patients were

| Age | C |
|----------|---|
| 0 to 4 | 0 |
| 5 to 10 | 4 |
| 10 to 15 | 3 |

METHOD OF TREATMENT AND RESULTS

| | |
|---|---|
| Punch operation all cured of obstruction | 5 |
| Suprapubic cystostomy with destruction of valve by punch cured | 1 |
| Suprapubic cystostomy with unsuccessful retrograde sounding punch operation at later date cured | 1 |
| Rupture of valve by sound before admission on septocemical death | 1 |
| Not operated upon when entering hospital | 1 |

RESULTS OF CASES TREATED

| | |
|--------------------------------------|---|
| Cured | 6 |
| Cured of obstruction but incontinent | |
| Not treated | 1 |

These results show conclusively that the punch operation was the method of choice but should

may be preceded by thorough preparatory drainage until functional tests show sufficient improvement in renal function to warrant an operation

ORIGIN OF THE CONDITION

A large amount of literature has accumulated concerning the origin of obstructing valves. In 1840 Tolmatschew attempted to explain the occurrence of the valves by stating that they were simply enlargements of the folds and ridges which commonly occur in the normal urethra stating that if these became hypertrophied obstruction would result. The occurrence of the condition in early childhood and even in stillbirths convinced early observers that the condition was one of embryological origin. Bazy brought forward the theory that the valves represented a persistence of the urogenital membrane. He derived his theory from the fact that this structure in its later development occupies the site corresponding to the common location of the valves. In 1914 Lowsley introduced another theory in which he concluded that they might be considered as anomalous developments from the wolffian and muellerian ducts. In 1918 Watson while working upon the embryological development of the verumontanum found in a cross section of the urethra in a fetal stage three fibrous bands extending from the proximal part of the verumontanum to the roof of the posterior urethra. They appeared to represent an attachment of the tip of the colliculus to the roof of the urethra and he drew the deduction that congenital valves were a result of fusion of the colliculus at an early stage of its development with the epithelium of the roof of the posterior urethra (Fig. 14). In our previous paper from this clinic there was made a very careful analytical study of the various forms in which the valves occurred. By studying critically the cases in the literature and our own we have concluded that the congenital obstruction always occurs as one of the three types or formations as shown. Our conception of the position of the three types is shown in Figure 15.

Type 1. In this the most common type there is a ridge lying on the floor of the urethra continuous with the verumontanum which takes an anterior course and divides into two fork-like processes in the region of the bulbo-membranous junction. These processes are continued as thin membranous sheets directing upward and forward which may be attached to the urethra throughout its entire circumference. In the majority of cases of this general type the fusion of the valves anteriorly is not complete. There

exists at this point a slight separation of the folds. However in a few of the cases of which Lowsley's, Knox's and Sprunt's are examples the anterior fusion is complete while a cleft exists between the folds posteriorly. Another subdivision which really belongs to this general type consists of but a single instead of a double valve.

Type 2. In the second general type of which we have one example there occurs a more or less cylindrical ridge similar to that found in the preceding type with the exception that it passes over the upper aspect of the verumontanum toward the internal sphincter. Here it divides into two fork-like processes which are continued as membranous sheets and are attached to the urethra just outside the internal sphincter in a manner similar to that described in the foregoing type (Fig. 17).

Type 3. There is a third type which has been found at different levels of the posterior urethra and which apparently bears no relation to the verumontanum as do the types just considered. This was first mentioned by Jarjavay who describes it as an iris valve because of the similarity in shape to the iris of the eye. This obstruction was attached to the inner circumference of the urethra there being a small opening in the center. Incomplete varieties of this type have been described the most common being a more or less crescentic or semicircular fold crossing the urethra and being attached either to the floor or roof (Fig. 16).

It is very evident from a review of the cases that there are considerable variations in the shape and position of the valves of any one type. Apparently no single theory as stated previously will explain satisfactorily the formation of all three types. This apparently suggests that the structures arise from a more variable structure than the urogenital membrane. We are inclined to favor Watson's theory as to their origin (Fig. 14).

SYMPTOMATOLOGY

The symptom complex characterizing the condition is very clear cut and with careful examination of the history of the patient the diagnosis becomes almost self-evident. The symptoms may be divided into two headings: first those brought about by a local obstruction to urination and second those resulting from the back pressure effect upon the kidneys producing renal damage, insufficiency and a resulting uræmia. The symptom complex under the former heading is sometimes very difficult to elicit. However upon carefully questioning the patient or his parents one derives a history of continuous difficulty in

urination since birth. The patient has always had difficulty in starting the stream and when started it has always been very small with a tendency toward dribbling. There is usually present a marked frequency and very often incontinence. This history of nocturnal frequency and incontinence in many instances leads to a diagnosis of enuresis. However the incontinence is always of the paradoxical type resulting from the overflow of a greatly distended bladder which never becomes completely emptied. In children the mother has usually noticed that the child has quite a large protuberant abdomen and that there has been marked growth impairment.

The symptoms coming under the second classification are those caused by the condition progressing to an advanced stage. They are those of chronic uræmia and simulate chronic diffuse nephritis or polycystic kidneys. They are briefly, anorexia, nausea, vomiting, headaches, loss of weight and coma in the last stages. It has also been noted that in these cases the resistance to infection is very much lowered due probably to the chronic uræmic state. Respiratory infections are very common and they simulate very closely with a very large residual urine, the old prostatic in their susceptibility to ascending renal infections. Upon physical examination one finds usually an anæmic patient having a greatly distended abdomen. Upon abdominal examination one finds a distended bladder usually bilateral masses in the lumbar regions consisting of greatly distended kidneys and bilateral hydro ureters may sometimes be made out on each side of the abdomen. The patient may be in any one of the several progressive stages of chronic uræmia. They have usually considerable nitrogen retention in the blood. Upon attempting urethral instrumentation one usually finds obstruction in the mid portion but a very small catheter will sometimes pass readily. Often however only a small ureteral catheter can be introduced. However retrograde instrumentation is very difficult due to the fact that the ballooned out valves in the posterior urethra furnish a very definite obstruction. In some cases urethral instruments are arrested by the valves. The prostatic urethra above the valves is dilated and the vesical orifice is often so dilated that the valves can be seen from the bladder (Figs 18, 19 and 20). There is marked hypertrophy of the trigone, the ureteral orifices are apt to be greatly dilated, considerable trabeculation, cellulæ formation and occasionally diverticula are seen.

A great help has been added to the technique of diagnosing such conditions by the introduction of

radiographic media. If the bladder is filled by the introduction of sodium iodide, usually a reflux up both ureters occurs filling the pelvis of both kidneys and the roentgenogram shows a large dilated bladder with bilateral hydro ureters and bilateral hydronephrosis. It is very interesting to note in viewing the X ray of such a condition that the ureter from its juxtavesical portion to its entrance to the pelvis of the kidney has become greatly elongated in addition to its dilatation. The weight of this elongated ureter when filled with urine tends to the formation of folds and kinks because of sagging. This kinking sagging and occasionally torsion of the ureter greatly increases obstruction to the outflow of urine from the kidney pelvis and adds to vesical neck obstruction, ureteral obstruction. The cystogram always shows dilatation of the vesical orifice and continuation of the opaque medium down the posterior urethra to the site of the valves producing the typical funnel shaped end to the cystogram which is different from the funnel seen in tubercles in which the funnel extends down to the external sphincter whereas in a case of congenital valves it does not usually extend below the verumontanum as shown in Figures 18, 19, and 20.

DIAGNOSIS

In the differential diagnosis of this urinary condition the history as mentioned above is of great importance. The presence of the protuberant abdomen in an undernourished child with difficulty in urination and often pyuria should make one very suspicious. The distended bladder can usually be palpated and percussed. The palpation of bilateral masses in the region of the kidneys and hydro ureters with a percussible bladder helps greatly to confirm the suspicion. The most striking feature in these cases is the ability to see and palpate the greatly distended tortuous ureters and marked hydronephrotic sacs through the emaciated abdomen of these marasmic children. In some cases that we have seen the greatly enlarged ureters could be grasped between the thumb and finger and were thought at first to be distended thickened intestines. When the symptoms and signs suggest prostatic valves it is very unwise to cystoscope the patient immediately because in doing so one suddenly empties the bladder, ureters and kidney pelvis of a large residual urine which the kidney has been working against under great pressure. We have found it advantageous to pass a small soft rubber catheter or in some cases even a small ureteral catheter and gradually

TABLE I—OUR CASES OF CONGENITAL ALAKES OF HOSTATIC URETHRA REPORTED IN 1912

| C
mb
d f | Ag | Imp m | Clm d l | D g | T tm t | Op d g | A f d e | R l | R i |
|----------------|-----|---|--|----------------------------|---|--|---|-------|-------------------------------|
| V F B | | U l y f
h | R t l
py p h
th
i g f m
h f | U th
p l
l
pos th | R r l f
f
h os pe | | R m l f
l T y
p
d oc b l
f l d
l l l d
l t l h d
d ph os | W l l | P f l
y ar b
d y
d y |
| V F I | | A l f
m | R l l | | | | O l b
l m
t f m
l h
l l t | D d | |
| V F I | m | P f l
f
m l l l
l f | D d d b l d j
b h
h pos f
l t an | | S f m p l h y
f l th my
w th l j | Th m m
f l l l w
m | | W l l | |
| V F B | | U l l
l | D p l p l m
h k j y d
l f
y d m
h po
l lo | C b l
l h | l m w h l y
l f l
l m y d | J b l w
l f
l l t | | W l l | l d y
d l h |
| V F B | m | N d m l f
l h l d b l m | C b m h
l m h | | S p l b y
m l h l
l l h po h
d | V l o l
p os
h | | W l l | |
| V F B | | I f l d
f
b h | La d l
U f py
h pos
C h m
d l | C b l
l | S t p t y t
m c l d l l | A b t l l
m
l b d
f os oof
h | | W l l | |
| V F B | d | V l m l
d
y | D l d b l d l
b h | A l d m u n l
m | F l l y
l t my | M l h l
c y | D h l b
l w m
l m | D l | |
| V F B | o | D u n f l
q y l g | R l l
h th
b t
l m g f m
p g f h m l | U b f l
l
l pos h | F h f l
h p h | l l l
f h h l
b l w m
m t m | | W l l | E l d y
par l y |
| V F B | 5 m | Lo m l h | D t l d b l d l
l f
l f | | | | Tw l l
b l l f f | D l | |
| V F B | y | U l l l
l h l d
h o o l f
q oc l | R l l l h
p y p h
h p g
l m m g
ph d l d d | U h y
l
l pos so | F h l l l | N l l l
f b l
m | | W l l | M k d |
| V F B | 3 m | Lo s d f m h g | F y u a | | | | Spec m d
y d | D d | |
| V F B | yr | D P
p b f p l | F y u pe
p p h
f f (po
pe t) | C f l l | S p p h h p os
m y l l f | | | W l l | |

TABLE II—CASES OF CONGENITAL LESIONS OF THE PROSTATIC URETHRA
REPORTED HERE FOR FIRST TIME

| C
mb
d d t | Ag | Symptom | Clin
d t | D g | T t m t | O
f l g | A t p s
f d g | R
lt | R m k |
|-------------------------|------------|---|--|--|--|-----------------------------------|--|--------------|--|
| B U I
8555
4 | 7 y m | Edg
d bbl y
g | Bl d d t R m d t
bl m m
m g l f m m
l f t t t t
f p o t
th m m t | C g t l
l | F h p t
(p h) N 7
m d p t f
m t m
m d | | | W l l | W th
f w d y
d g
ly 3 t 4
t m d t
g th l y
d h l d g
h sht t |
| B U I
87 8
4 f | 7 y | l t t l l
d oct l l
f q y | Py R t l l
g t l l f
p o t th | C g t l
l | S t p b y t t
m y P h P
p t f s o d | C l t l
l t t l p
t t l u s | | W l l | S t h l d
t m p l y
U n t g
m l l y
N k
l l t
l t |
| B U I
9 3
8 7 | 3 | l t t n l d
d oct l d | R d l s s m
D l t t f
p o t th
(X y) | C g t l
l | S p p b y t t
m y p t f
l w th
l t d t p h
p t | C t t t D
l t d p o t
th | | Im
p d | T i
p b
p t l
l y d t
t m
d y d
t t m
t g h t
l m h
t t m |
| B U I
55
6 | 9 y | l q y
(d t n l) | I t l l g
d l t d y y
f m g p d f
m t m | C g t l f
p t thr | F h p t f
D l t t f
th ds | Co l t l | | Im
d | C a p t y 4
t g
(b f
p t
d p m)
D b b l g
d g d y
f t t |
| B U I
4 7
5 4 4 | 5 y | N t l
H a m t
l q y | M t l l g u g t
D t d d
t b l d d R d d
l f m
V l f p o t
t b
B f d t d
p l u s l f t h y d
t d h y d
p h r o s i s l l
g l t y p f
b l d d | C g t l
l
p o t
th
D u l a t d
p o t
H y d r
p h u s
l f t | R t t t h t
B l d t f | | C g t l
d t t l
t d t f
t h
l y l p h t
d c y t t | D d
7 7 4 | E t d h
t t l
p o o
d t |
| B U I
5354
3 6 | yr | D t l y
t g
Symptom
a e m | D l t d b l d d
t t g h y d
t t B l t l
h y d p h u s
N P N o m g m
C t u m
m e m | Co t l
l
p o t
thr | I h p t t
D l t t t t h
ds | | | W l l
y | N m l
b l d
h m t y
L d a l
l f |
| B U I
3 4 9
3 3 5 | yr
9 m | D y
g y
H a m t
U e m | D i s t d d b d
m t h y d
m t U e m | C g t l
l
p o
t th | D m p d
b l l d | | | D d
f s | I d h o s
p l l
a e m
P g
l y m
a e m
D t h
a e m
m m |
| B U I
6633
4 7 | 7 y
3 4 | D y
l y
C l l l b d
f q c y | S t p p g t t m
d a n g t
C l d y | C g t l
l
p o s
t th | V l p t t l l y
p t d b y p
d g
t t d b y f
q d b l d d
l a g t | | | W l l | R m m f
t t
f t y t
p o |
| B U I
6577
9 4 7 | 4 y | D t d d
b d m
D y
F y u a I
t u n | D t d d b l d d
B l t a l h y d
t B l t I
h y d p h r o s i s | Co g t l
l
p o s
t th | P h p t w th
D l t ds | | | W l l | W l l
m th
G l
w g h t
V d s
f l y |

TABLE III.—CONGENITAL VALVULAR OBSTRUCTION OF THE POSTERIOR URETHRA
COLLECTED CASES FROM THE LITERATURE

| A h d | Ag | Sig | I m p m | Cy p ph d | T tm | R m k |
|----------------|--------------|--|------------------------------------|--------------------------------|--|---|
| B d i
8 | 6 | U | d po y d g | | | A p y h d h l t hydr hr ph d
d h dr d Blad h pe
d d l i l u l b tr |
| B i | 1 | P | m k i f k h d b
l m l d t l s y | | | A m m p y h d d
bl dd d Bl hyd fl b f h l
l t phy pb |
| d | | | | | | A t p y h d m b l t l l
f d m t m pos l k h h |
| P 8 f | | D m l | d b l d d l D d | | | A p y h w d l l b t b l
h m d hydr m t Bul l h dr |
| l m h
87 | | | | | | A p m h w d m l j t b l th |
| E g b d
8 8 | 5 | U | d m l f b y d d
f l m pl | | p p b y t
m m b f d
h l k
b t d v l
d tr d | V l d f i l d
hl dd P b l y l p
th l l N m l R p
t d g d t m l s good bl |
| P p | | D m l y
h l h o o i P l j
m b d y | | U hr sc h d m m m
m m b b k | R d i P b
d i f l l P g day | A p y h d m l k m b h l l
m g t m t k Fl d h kae
Bul l hydr h o d hydr |
| h | | | | | | V l u l t m p f b ta fill
g hyp pb f b ta fill |
| t k | S l l
h h | | | | | D y d t l g i h d o m L s
h t l d d m l post
h h m f l i n h p f l
w h m y t d h l d u E i d
th m m b b t s
h i f f t h m t a m d Bul l hydr
d hydr phr |
| bl h f
8 | D d
b h | | | | | V l u l b t l d f r u
m t m |
| m m d
8 | D d
b h | | | | | A l h d d l m l l k m Bul l
h d hr d f m m Bul l |
| l h | f m | | | | | A t p m h w d l l k d g ph os
d hydr Bul t l h dr |
| l h | l l
b h | | | | | A p y h w d l u l h b l
m t m m Bul l h dr |
| L l m | m | E d m f l d d | | | | A h h d m l u l b b l bel
ph d h dr m Bul l hydr |
| L d m | | A l l l f d | | | | P t d d f d ph th A p h d
l l b m t m Bul l hydr h o
d h d |
| L d m
9 | s | l d r l f b l d j D | | | | A h d l l b m t b d f l
h dr ph by d h dr |
| l | m | A t d m l d d m
h d r p e x d w h | | | | A p y h w d l u l a b a o f
phr d h dr hr Bul l hyd |
| l os | | l f f l l d b
m m a g h k d m
Bl d d d d b m u r a | | | F th | P b bl t d f m m b h l l h
N |

TABLE III—Continued

| A th d t | Ag | Sg d ympt | Cy t py d g phy | T tm t | R m ks |
|------------|-------|--|--|--|---|
| Th mps 907 | 4 m | Dys ia d d ff lty
t D t d d h d d | | S p p b cy t t
my | A t p y h d m mb l la b
t t l po t th |
| l t h 908 | 3 m | Abd m l d t t C
vul p gr ss
m d m l t t Tu
m m p l f t q d t
lso m l f n ppe
ght q d t d b
ymphy | | Op t t bek
b t t pn d m
m d t by b ca
f p t t p
d t | A t p y h w d 3 m mb l l k
b t t l po t th B t t l
hydr ph n po t d hyd o t |
| W l k 9 | y | D phth f days C
l | | | A t p y h w d l vul b t t t
t m t m |
| Led 9 | yr | U n y d ff lty 3 y
d d I m
d d pyu | | | A t p y h d m l daph gm t
m mb b t t l hyd ph d by j
t |
| K Sp d 9 | 5 yr | I t d d py b tl
M k d py Lo
ught d t gth D
t d d bl dd l
both k d y g | | | A t p y h w l l vul b t t t t b
m mb b t t l f l hyd
ph is d hydr u t |
| H 93 k | 5 yr | D ff lty thoe t l m
p l t t t t
mark d pyu | | S p p b y t t
my | A t p y h w l l t t l d f
m t m B l t l hyd ph |
| J d 93 | 4 k | C t d d r bbl g | | | A t p y h w d f b
th l l e
t t t t f post
po t |
| I 94 | 85 y | Hem t l d ff lty f
bl dd | | R p e t d th t
f l l p sag
p l d p t
th | A t p y h w d l g d m f post t
al p b bly t f t f m f l p g |
| Low l y 94 | 34 m | Acu ly ll p lm y
ued m | | | A t p y h w d l vul b t t t t
th B l t l hyd ph p t d
hy l r |
| H m d 97 | 6 yr | K d y t bl w th
f d m t g P ds
t t f y l f lty d
y d t C y t t f | Cy t thoe p l
mun t h val
m mb
th post thr | S p p b y t t
my d t t l
th t my w th
d t t f
m mb
l po t | U m t t k l m th l t
t d d d p p b cy t t my f
p m t f t l |
| H m d 9 | 57 yr | D l f q y w thoe
l h y d m h f
g u l f
t m 4 m th d t | Cy t thoe p l
m l h w d
l l k f m t
th p t cr t l
M d k w th d f t b
f d f m t | S p p b cy t t
my w th d m
f l b | P t t d g m lly 4 y ft pe
t R d l y t t |
| H m l 9 | 4 yr | P l t t t d d b
bl g t l d d b
f q y oca l f th
dy a l t | R d l f s th m
p t t th t l
p t d d t t m
ph t f f t
t h w d d a t
m m mb
f l d s f b p
g l l k
bst t C y t
g m l w m k d
d l t t d l g
t l l f t t | D t t f
l by
f lgu t | Able t l good t m Ph t l h
t l l h d f m 35 t 5 p t n h
y t t p t |
| H m d 93 | 4 yr | P ght l w th part l
t t k d t m k d
dy | Cyst py l d
l l k
f m t t d t f t
m t m | V l d t y d by
f lgu t | Imm j t l f t y m k l P t t
t t h t f |
| H m d 94 | yr | C t l t bbl g f
U bl t l g t t m
l f y t bl | Cy t py f d
l l k b t t
f m t t
py l g phy h w d
bl t l hyd ph o
d hyd t | S p p l y t t
my w th p l t t g
f l po t
th l l k
t l | Ab l t l good t m P t t d p
t t m p l t y h g l t h p
t t m t C y t t l l p |

TABLE III—C t d

| A h d | A | S g d ympt m | Cy t g p phy d | T m t | R m k |
|-------------------|--------------------------|--|--|---|--|
| H m d
K m
9 | 8 yr | S ling fl g d l
w k m) Alb min l
p m)
d t M k d py y
N d m ly b | N t bl ns y t
V w bl d l
e-th ht t h m
l l bt
P t so thr
C g m h w m l
bl d m k d y d
l t l d t l ft
d
l f k d y ph | S p p b t t
m y f
d m g p l
m s m a | D d f th d y p o t p
A p y f in r y t h d to l us
p l k l f t larg d
p ung po h f po th l f
k d t ph d ght t d l ted
g h k d n y hyd ph s c b t ho l i
d g r l |
| l b g | 8 yr | E d f q y
l du g mark d dy
d py m B t g m
l f l m | Cy t py
l l Arg 15 p t
Cy t g m h w d d
l f d h d d
blat l hydr
d py phr | | C d pp d— f l l w p |
| R d l l | 5 y | D y d t t pt f
h p) D w y try t | M mb t b r
t m t m P
m m g f m gh
— c l t b w d
b l l py y | F l g t f
K do y
p l l g d
with
AgNO ₃ p | P t w l l y l i |
| R d l l
9 | 6 yr | F q y d u f
y d
w h p p b p m Al d
l gh b m t | P t t th du
l d V l d A
d d d l d A
m r y f m
t m l s d
f l m t d m g
d t l h b t m
d m d d g f m
l m b d
Cy g r m—m l l
bl d d w b g b
b r phr u s d
hydr u | D t f f
l l by f l g
t | Abl f f l y f l l w g t m t |
| M in J
9 | yr | Hyp p du w th p f l p l
l k d y p y d b m
t d t Cy f y
f m d f b m p
d u s g o | U hr p h w d
m o o h p a t b b
th m m | S m p b Cy t
w b
t l f m l
p t a t thr s | S m p t m m p l h d R
b f a s o c w b b p o p d |
| G l n | yr | D d U h p m l
s bl y f m f t b | U hr p h w d
b d m p b d
f t b b d
pos d h y f
th l l f d
wall f w b pos
tr t th w g l t | D tr y d thr gh
th d p | Abl t d d b h d f l |
| G l n g | | U h f y d f
U bl f y d t L
p | U th s c py h w d
h m l k b d
w h m l l p g
b d | D b y d hr gh
b b p | E d l t s t d |
| M d R b
3 | 5 y | E du sa d | N d | | A t p y h w d h d r phr k d y d
h d r w h d s in f f l d f m co
m mb w th l l k b
p o t hr p m g t w d th bl d
d |
| S h m d
3 | S ul
b th
7 m
m | | | | A t y b w d m k d y d s d d bl d
d and bl l hydr phr d hydro-
te U h d m t bl d d
g t l s d g r d f l d f bl d d
m m b a n f m d t l k b-
tr m t k |
| H m | m | Lo f w g b p tal
m u s and r r bl
S p b mass l b h y
l D p m w h l l
g s | | | A t p y b w d bl l y ph o s d
hydro- Bl d d thick d p
hr f m l s h d Tw m mb
f l d s g f m m
l m u n g al l k b r u t |

TABLE III—Continued

| A th d d | Ag | Sg nd ympt | Cy t py n l
g phy | T tm t | R m k |
|-------------|-----|---|---|--|---|
| B 9 4 | yr | l p d j t p ds
d bbl g Bl dd t m
bluc -4 d p m Al
b k l d p lm y t | Cy t g m h d ds
f t f m g t th
f m g h p d
p oc l m d d f
wb h l p d g t th
p j p d g l l l
d f g t st | S p p b y t t
my—d th t
f w day d t
p | A t p y—bl dd h d th k g P
t t u th d nt l ph t d l t d
C l l j t d f m d l w l l b
l w l l l w g t t l f m l
f m l l f l d p a t g t h p t t d
m mb th as Bl t l hydr
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decompress the bladder in the same way that one deals with large residual urine secondary to prostatic obstruction. After the urinary tract has been emptied and a point of equilibrium has been established in the blood chemistry a study of the bladder may then be carried out. The cystogram can then usually be carried out favorably with the patient's head depressed so that the fluid can easily flow upward into the dilated ureters and kidney pelves. This filling is allowed to progress until the entire urinary tract is completely distended when the catheter is removed and a stereoscopic roentgenogram is taken after which the catheter is reintroduced and with patient in a sitting posture the shadowgraphic fluid is allowed to escape completely and the bladder is washed out thoroughly with salt solution to avoid irritation. There may be some reaction following this examination and as a rule several days should be allowed to elapse before carrying out the second important step viz cystoscopy. A child's cystoscope is usually passed into the bladder and by withdrawing this one can view the valves in the prostatic urethra. The instrument can be used to study the prostatic urethra because the vesical orifice is dilated. When the irrigating fluid is turned on and off the valves balloon out and then partially collapse. A small straight tubular air urethroscope is also an excellent instrument for studying the valves. The internal sphincter has been found dilated in our cases and one notes a funnel shaped dilatation of the prostatic urethra

quite similar to that seen in prostatectomy in cases in which the internal sphincter has been damaged but not extending below the verumontanum. The bladder presents a picture of obstruction. The trigone is hypertrophied the ureteral orifices are usually dilated and the bladder wall shows marked trabeculation, cellulules and sometimes diverticula. A cystogram should always be taken. Dilatation of the upper urinary tract is present. In some cases regurgitation up the ureters does not occur and one is uncertain whether dilatation of the upper urinary tract is present. Cystoscopy is always indicated for correct diagnosis. Sometimes it is very difficult to introduce a child's cystoscope and in such cases filiforms and followers are first passed. When difficulty is encountered it is partially due to the beak of the cystoscope meeting obstruction in a pouch in front of the valve or at the verumontanum itself. In the iris type of valve the aperture in the valve is occasionally not large enough in diameter to admit even a small cystoscope. By means of a urethroscope an excellent view of the valves and opening between them may often be obtained. In an adult a No. 26 straight tube may be employed. In boys of 5 years of age we have had no difficulty in employing an endoscope made from a No. 15 tube. For very young infants it may be necessary to prepare urethroscopes with tubes of smaller caliber. The urethroscope shows the opening between the valves much better than the cystoscope the beak of which has to be passed through them.

before the valves are seen. The condition should be differentiated from congenital polycystic kidneys and the condition known as congenital hypertrophy of the verumontanum as reported by Bugbee and Wollstein. Recently in this clinic we have had a number of neurological disorders occurring in children with a condition of pinabulbia occulta present which may suggest congenital valves. These children have the large bladder difficulty in urination paradoxical incontinence and symptoms of chronic uræmia. The cystoscopic and radiographic methods make differentiation easy.

TREATMENT

As shown in the cases which have been given in detail above the ideal treatment for valves of the posterior urethra appears to be as follows:

Careful abdominal examination should be made to see whether the bladder, ureters and kidneys are palpably dilated. Blood ureas should be taken to see whether renal impairment is present. Instrumentation of the urethra should be carried out delicately to detect the valves, to note the position and if obstruction is met with to find some instrument generally a small pointed urethral catheter which can be passed through the slit between the valves to catheterize the bladder. Care should be taken not to empty the bladder too rapidly. A small catheter will however allow only a small escape of fluid and the decompression apparatus is usually therefore not necessary. If the evacuation appears too rapid even through the urethral catheter the outflow can be diminished by carrying the catheter over a slight elevation. If a larger catheter is used in the presence of a markedly distended bladder we have found the Young Shaw decompression apparatus very valuable not only to determine the vascular pressure but to provide drainage under gradually lessening pressure for several days until the apparatus can be safely removed and free drainage through a dependent catheter permitted. In one of our cases we now believe that the evacuation was too rapid and that by prolonging the decompression fatal result might have been avoided although the renal function was very bad. When the bladder, ureters and kidneys have been thoroughly drained if the condition of the patient warrants it one should make a cystogram. Sufficient fluid to fill the bladder, ureters and kidney pelvis (if reflux is present) should be introduced. Stereo-films should be taken so that the contour of the bladder, ureters, kidneys and the funnel shaped projection into the prostatic urethra may be clearly seen. The

sodium iodide solution should be carefully drained away and lavage of the bladder carried out to avoid irritation. Cystoscopy should be carried out as soon as the condition of the patient permits. By using a very small No. 12 child's cystoscope one can usually penetrate the slit between the two valves by careful manipulation and thus obtain an excellent view of the bladder and prostatic urethra during which the valves can usually be seen and their extent and site of attachment described. In one case in which it was possible to introduce the cystoscope into a dilated ureter we were able by using the extra long straight operative cystoscope which I employed in Young's cystoscopic lithotrite to introduce the cystoscope up to the pelvis of the kidney and when with drawn the greatly dilated ureter with its convolutions and tortuosities and valve like septa were seen (Fig. 2). Unfortunately the operator failed to try to identify the renal papillæ and jets of urine which are supposed to come from the urinary tubules but we believe that this might easily be possible in some of these cases. Endoscopy has also been carried out in some of these cases with a special small child's endoscope. In this way a better view is obtained of the aperture between the two valves after the endoscope is drawn outward below the level.

PREPARATORY TREATMENT

These cases require practically the same preparatory treatment as cases of prostatic hypertrophy with marked back pressure and much residual urine. As noted above great care must be taken in providing slow evacuation of the greatly distended bladder, ureters and kidney pelvis the condition of the patient being carefully studied by renal function tests (non protein nitrogen output and phthalein) and blood pressure and cardiac examinations to determine the effects of decompression. Drainage should be maintained until the drop in non protein nitrogen and increase in phthalein is sufficient to warrant the slight operation necessary to remove the valves. One cannot expect restoration to normal and in many cases there is still a marked impairment of renal function when the valves are excised with the punch.

The punch operation. In boy babies it is quite possible to pass a No. 7F punch instrument into the urethra and by careful manipulation through the aperture between the valves and on into the bladder. The bladder is then washed out and filled again with a weak antiseptic solution. It has seemed wise to remove only one valve at the first operation. This is carried out by turning

the fenestra of the instrument to one side with drawing the outer sheath until the valve is entrapped in the fenestra. A few manipulations back and forth will determine that this is correct and that the instrument has not escaped beyond the valves. When the inner tube is pressed home the valve is completely excised and removed and the instrument is then withdrawn (Fig. 1). The patient can then be removed from the table and should be instructed to void. If urination is free and the stream forcible it is probably not necessary to introduce a catheter and if during the next few days micturition continues satisfactorily no additional operation is necessary. Should it be evident that the obstruction has not been completely removed another cystoscopic examination to determine the presence of a remaining valve and an additional cut with the punch instrument on the opposite side may be advisable. In one of our early cases one of us (Young) undoubtedly overdid the punch operation in taking five cuts and as a result slight incontinence persisted. Since then no cases of incontinence among the 7 cases treated by the punch have been recorded (Fig. 2). If immediately after the operation the patient is unable to void freely or if the phthalein and non-protein nitrogen output tests show considerable impairment of the kidneys still present it is probably better to employ a large urethral catheter for drainage and free evacuation of the distended urinary tract. Such catheters should be removed every few days and the duration of the drainage determined by the progress of the improvement in renal function, etc. The punch operation is so simple and painless that in most cases we have found anesthesia entirely unnecessary. In several of the cases which we have encountered and recorded the valves have been ruptured by the passage of instruments, sounds, catheters, cystoscopes, etc. In such cases it was possible to see the ruptured valve leaflets still attached to the verumontanum. In some cases even though it was possible to pass a fairly large instrument valvular obstruction persisted to a certain degree so that the punch operation was required after the use of marked dilatation and sounds. The objection to the use of sounds is that false passages may sometimes be produced. In one of our cases we found quite a deep pouch in the floor of the urethra beneath the valve into which instruments passed. It may even be necessary to use filiforms and possibly a punch which may be attached to a filiform in order to get the instrument through the aperture between the valve. If instrumental rupture of the valves is the method of treatment em-

ployed the pre-operative and postoperative investigation and care should be the same as that described above for punch operation.

Suprapubic operation. In the first case in which the condition was discovered and cured by operation in 1912 Young opened the bladder suprapubically and discovered the dilated prostatic urethra and a thin valve was detected by palpating upon the end of a sound which had been passed through the meatus. By means of a knife and rongeur the valve was easily excised completely after which large instruments could be passed through the urethra into the bladder. This procedure has been carried out in this clinic in several other cases but since demonstrating that the punch operation is entirely satisfactory we have personally always adopted this in preference to the suprapubic or any other method of attack.

Perineal operations. This method of approach was suggested as an alternative route in the paper by Young, Frantz and Baldwin but we have personally never found this necessary or even advisable. Hinman has advised urethrotomy of the bulbous urethra for the passage of cystoscopes or other instruments and through this has carried out fulguration.

Fulguration. This was first carried out by Alexander Randall who reported two cases. By means of the high frequency current and a ureter catheterizing cystoscope the valves were destroyed by fulguration. Four additional cases have been reported by Hinman in which this method was employed. By the use of a child's single catheter cystoscope of No. 15 F size no great difficulty should be experienced in introducing the instrument and carrying out fulguration. In boys in older cases the larger ureter catheterizing instrument may be satisfactorily employed. In babies one may encounter considerable difficulty in introducing the catheterizing cystoscope. For such cases we constructed our first baby punch and have found this so satisfactory that fulguration has not been employed in any of our cases. It would seem more radical and surgical to remove the valve by excision with the punch and it gives a nice specimen of the valve for examination. Fulguration is however we believe quite preferable to rough dilatation with sounds.

PROGNOSIS

Prognosis depends very greatly on the extent of the obstruction, the character of the renal impairment and general condition of the patient. As this condition is present during fetal life these patients are usually born with urinary incontinence and some degree of renal impairment. In a few

cases the valvular obstruction is undoubtedly responsible for stillbirths and in others the patient lives only a few days or weeks. When at birth examination reveals an emaciated unhealthy boy with a distended abdomen one should be suspicious of congenital valvular obstruction. If palpably enlarged bladders kidneys and ureters are made out the diagnosis is practically certain. An attempt to pass small instruments will usually reveal the site of obstruction in the prostatic urethra. Continued efforts to pass small ureteral catheters will generally be rewarded by evacuation of urine and the subsequent introduction of sodium iodide and X ray examination will make the diagnosis positive and delineate the extent of the ureteral and renal dilatation. Only by the greatest care will it be possible to save the lives of these desperately ill children and in some cases the impairment and general deterioration is so great as to make it impossible to save them. Where it is possible by careful preparatory treatment to improve the renal function and general condition sufficiently so that the operation may be carried out complete cures may be expected in a large percentage of the cases as shown by the fact that we have now operated upon 15 cases without an operative death. All but two have apparently been permanently cured or greatly improved.

SUMMARY

We report herewith 21 cases of congenital valve of the posterior urethra which have been seen at the Brady Urological Institute. Two of these cases were reported by Young in 1913 and were the first cases in which operative procedure was carried out for this condition which had been recognized clinically. In a second paper (Young, Frontz and Baldwin) 10 additional cases were reported. In this paper the 9 other cases are given in detail. Of these 9 cases 7 were operated upon successfully 5 of which were treated with Young's baby punch with excellent results. The results in all these 9 operative cases have been excellent. Of the 21 cases which we have now seen 15 have been operated upon successfully.

We have been able to collect from the literature 41 cases of which 12 were treated by operation all since our first report. Of the last 9 cases seen at this clinic all have been under 16 years of age.

The following things are stressed the importance of complete urological examination and of a careful history the search for dilated bladder ureters and kidney pelvis the necessity of blood chemistry if valvular obstruction and renal impairment is suspected delicate instrumentation to detect the valvular obstruction careful efforts

to find the aperture between the valves by means of pointed ureteral catheters in order to drain the bladder the necessity of gradual decompression to avoid shock uræmia etc the use of the cystoscope or urethroscope and cystogram to demonstrate the valvular obstruction the dilated prostatic urethra above it the dilatation of the bladder ureters and kidney pelvis into which the fluid usually flows by reflux the necessity of careful preliminary treatment before operation is undertaken the great advantage of the punch operation with minute instruments especially prepared to fit the caliber of the urethra given in detail in the cases cited.

The results obtained with this method are highly satisfactory. We wish to bring this condition before the profession in order to stress the importance of early diagnosis from a properly obtained history and physical examination and to show the simplicity of its treatment with the punch operation and the excellent results which may thus be obtained.

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SURGICAL TREATMENT OF UNDESCENDED TESTICLES

C C HIGGINS M.D. CLEVELAND O. 10

Cleveland

AND

H WILLY M.D. PARIS FRANCE

Omb. de C.

ALTHOUGH the chief purpose of this article is to describe in detail Ombredanne's technique for orchidopexy a brief review of the literature concerning various phases of the treatment of undescended testicle may not be out of place.

Since the earliest publications of John Hunter dealing with the undescended testicle numerous articles on this subject have appeared in the literature. The etiology has been discussed and many theories have been advanced as to the causative factors of this condition. Many types of operation have been described which have been undertaken in the attempt to restore the testes to their normal position and to preserve the function of these organs.

INCIDENCE

Statistics compiled by various authors agree quite uniformly regarding the frequency of this condition. Marshall reported an incidence of 1.02 per cent in 10,800 men examined. Ziebert in examining men for the Austrian army between the years 1870 and 1882 reported 14,037 cases among 6,965,433 men an incidence of 0.2 per cent. In the report made by Eccles undescended testicles were found in 1 per cent of 48,000 cases of hernia. Bevan states the frequency to be one in 500. In reporting the frequency in relation to the age of the patients Coley later stated that undescended testicles were present in 3 per cent of 14,100 boys under 14 years of age in 2 per cent of 3,848 boys between the ages of 14 and 21 in 0.2 per cent of 37,370 males over 21 years of age. Hofstaetter examined newborn males in order to ascertain the frequency of this condition. Among 450 male children born at term he found that 96 per cent were normal in respect to the position of the testis. Among 150 male children of premature birth in 68 per cent the testicles occupied the normal position and in nearly every case after 8 to 10 days of extra uterine life the testicles were in the scrotum or could easily be slipped through the external ring. Burdick and Coley reported that 452 cases of undescended testicle were found at the Hospital for Puerperal and Crippled between the years 1891 and 1924. In this group the relation of incidence to age was as follows:

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abnormal descent may be due to a combination of factors which varies with the individual.

Adhesions are frequently present between the vas deferens and the adjacent tissues in the region of the internal ring or between the processus vaginalis and structures of the inguinal canal. At the same time the spermatic vessels are shortened to such an extent that the placing of the testicle in the bottom of the scrotum without tension is rendered practically impossible. Alvisato, however, states that the shortness of the vessels is an effect rather than a cause of abnormal descent. Turner ascribes this condition to faulty position *in utero*, stating that abnormal pressure of the thigh against the inguinal canal prevents the complete descent of the testicle into the scrotum.

Cases have been reported in the literature in which the condition has occurred in several generations of a family—Finotti, Buedinger, Gosse, in Vidal, Hofstretter, and others having observed this tendency.

PATHOLOGY, ANATOMY, AND HISTOLOGY

Upon gross examination we find that the undescended testicle is usually smaller, less elastic and less firm in consistency than is the normal testicle. Sometimes, but very seldom, the testicle does not have any connection with the vas deferens and sometimes also only some yellow tissue is to be found, a trace of the undeveloped testicle. Some times there is no testicle at all. Usually, however, the undescended testicle is present but, as we have said, is smaller and less elastic than the normal testicle.

Histologically considered the undescended testicle has certain features which are constantly present. The investigations of Odierne and Simmons revealed thickening of the tunica albuginea and of the basement membrane of the tubules. Diminution in the number of spermatogenic tubules also may be noted. These cells, which are few and irregular, may show evidences of degeneration while the cells of Leydig may be increased in number and well developed. The absence of spermatids may be strikingly noticeable. In fact, Uffreduzzi states that spermatogenic cells are present in only 10 per cent of the cases. Crull reports that these cells may also degenerate as adult life is reached and that most of the testicular tissue is then replaced by fibrous and fatty tissue; however, interstitial cells are usually present. If these cells are present—a condition which is responsible for the internal secretion upon which depends the development of secondary male characteristics—should the testicle be removed in such patients?

Many authors advise orchidectomy if the opposite testicle occupies the normal position; however, we see no rational cause for removing the undescended testicle and the presence of interstitial cells would seem to be a forceful contra-indication.

Ombredanne's opinion is as follows: Before puberty an ectopic testicle looks on section like a normal child's testicle. Its epithelial cells are normal. The interstitial cells are proportionately more numerous than in an adult's testicle, but this is normal in a child. After puberty the interstitial cells are very numerous and this is an argument against orchidectomy if it can be avoided. After puberty, however, one will find only a few spermatozoa, very rarely spermatids, and never spermatozooids. So that if the operation is to be useful, one must operate on the boy before puberty, because at that time the testicle is normal and one can hope that the testicle placed in a normal position will grow normally.

COMPLICATIONS

Many complications may be associated with the abnormal descent of the testicle. In the ectopic testicle there may be found (1) a malignant growth, (2) torsion, (3) pyo, (4) inflammation, (5) atrophy, other complications which may be observed are (6) hernia, (7) hypogonitism, and (8) psychic disturbances.

The association of a malignant condition of the testicle with its abnormal position has been discussed in a previous paper. Tanner collected 600 cases of malignant testicle from the literature up to the year 19. Of the 452 cases of malignant growths of the testicle reported by Cunningham, 412 occurred in normally placed testicles. From Cunningham's report we may draw the conclusion that a malignant growth is fifty times more likely to develop in undescended testicles than in normal testicles, since the ratio of the incidence of the former to the latter is 1:500. Bulkley states that among every seventy-five testicles retained in the abdomen, one testis will become malignant, and Keyes also states that testes retained in the abdomen are more likely to become malignant. Ombredanne points out that although a malignant growth is frequently observed in these cases, it occurs only in adults. The association of tumors of the testicle with cryptorchidism in horses is well recognized.

Torsion may also occur especially in cases of the type designated by Eisendrath as "migrating testes." In these cases, because of a congenital deficiency in the internal oblique muscle and its conjoined tendon, the testicle can more readily be moved upward and downward.

Sometimes an ectopic testicle will cause some pain when the patient is walking sometimes especially in adolescents neuralgia will be noted. Pain like torsion is especially to be noticed in cases of migrating testicle. Ombredanne thinks that torsion rarely occurs in an ectopic testicle.

Because the abnormal position may favor trauma inflammation or orchitis may occur. In fact orchitis in an ectopic testicle gives special symptoms which are correlated with the position of the testicle and may appear to be unusually grave. Peritoneal symptoms are observed and a differential diagnosis must be made between orchitis and strangulated hernia torsion or in case the testicle lies in a deep iliac position appendicitis. In such a case one must always look for the testicle in the scrotum in order to avoid mistakes. Gonorrhœa is said to be very prone to attack the undescended testicle.

The association of undescended testicle with hernia has long been recognized. In a series of 80,730 cases of hernia, Coley found 1,357 undescended testicles while Eccles reports 854 among 48,000 cases of inguinal hernia. Uffreduzzi states that 90 per cent of incompletely descended testicles are associated with hernia. Schonholzer states that hernia is found in 95 per cent of the cases. Rawlings in 75 per cent. Odierne and Simmons in 57 per cent while Rossing states that hernia is present in 100 per cent of the cases. On the other hand Turner reports a series of 43 cases of undescended testicles of which only 17 were associated with inguinal hernia. However in spite of the disparity of the figures regarding this association it is evident that hernia is frequently present in cases of undescended testicle.

ATROPHY

Atrophy ensues if the testicle is not restored to the normal position. The investigations of Moore which were carried out on animals demonstrated that if the testicle occupies a position in the abdominal cavity the intra abdominal temperature is too high for the preservation of its normal function. He also showed that if the normally descended testicle is placed in the abdominal cavity a microscopic examination will reveal degenerative changes of the seminiferous tubules in as short a time as weeks. However if the testicle is replaced in the scrotum before too long an interval of time has elapsed it will again assume a normal appearance.

Either of two types of hypogonadism may be manifested clinically in cases of undescended testicle namely Froelich's syndrome or congenital hypogonadism. Evidence of such a condition

should be sought in the examination of these cases.

TYPES

There are two chief types of undescended testicle that in which the descent is *incomplete* and that in which it is *faulty*. Among the cases of the former type the abdominal and inguinal positions are evident. In the latter type of case the testicle may occupy a portion of (1) the pubic region above the symphysis pubis (2) the femoral region over Scarpa's triangle or (3) the perineal region that is the region lateral and external to the scrotum.

In Coley's series the inguinal position was most common occurring 73 times among 537 cases the second most common location was in the upper part of the thigh as observed in 13 cases while the pubic or perineal position was not observed in any case in Coley's series.

DIAGNOSIS

The diagnosis can usually be made with relative ease. If the testicle is not found in the scrotum the areas mentioned above should be examined to ascertain the position of the organ which is usually identified as a small elastic ovoid mass. The testicle can usually be palpated by careful manipulation of the inguinal canal and by gentle pressure downward and inward toward the pubic spine but it is not always possible to palpate it even when it occupies this position.

Occasionally during examination the cremasteric reflex will draw a normal testicle high into the upper part of the scrotum and this temporary position may be misleading. A migrating testis such as has been described by Eisendrath may move freely upward and downward and if it is in a child a marked change in its position will occur if the child is straining or crying.

AGE FOR OPERATION

Opinions vary as to the correct age for operation. Certainly it should be done before the age of puberty is reached and preferably between the ages of 8 and 12 years. Broca states that operation should be performed early. Sonneland advises operation between the ages of 10 and 12 years. Meyer 8 to 10 years—and even earlier in bilateral cases. Coley operates between the eighth and twelfth years while various other authors advise later periods—Duchesne operates between the ages of 10 and 20 years and Carlier between 17 and 25 years. After the eighth year the testicle has the opportunity to descend normally and moreover the structures are larger and more easily recognized than in earlier years.

As we have already noted according to Ombredanne the histological picture presented in cases of ectopic testicle makes it essential that operation be performed not later than the twelfth year. In general he advises operation during the period between the sixth and eighth years in those cases in which the small testicle has not descended below the pubis recommending also that the parents be told that the testicles of the child may or may not descend but assuring them that the chance of obtaining favorable results is greater if operation is performed.

INDICATIONS FOR OPERATION

The complications which may accompany undescended testicle indicate the advisability of performing orchidopexy. However if by manipulation the testis can be brought to the bottom of the scrotum operation is contra indicated as descent will always occur at the age of puberty.

In some cases a testicle which cannot be brought to the bottom of the scrotum by manipulation may descend normally in the period between the tenth and twelfth years. Usually however if by manipulation the testicle cannot be brought to the level of the pubis at an early age it will not descend unaided at any later age.

When the testicle cannot be found clinically operation is indicated. The physician should always tell the parents however that cases do occur in which the testicle cannot be found even at operation.

As for the results of operation the following figures show the location of the testicle after operation according to a report made in 1906 by Burdick and Coley. The results which were reported simply as satisfactory without any record of further observations are classified as not stated.

| P | C |
|-----------------------|-----|
| Not traced | 120 |
| Not stated | 17 |
| Not palpable | 13 |
| Inguinal canal | 13 |
| Outside external ring | 77 |
| Upper scrotum | 64 |
| Scrotum | 114 |
| Thigh | 9 |
| Total | 537 |

Excluding only the cases which were not traced satisfactory end results were secured in 42 per cent of these cases this rate being based on the assumption that from the standpoint of location after operation a testicle in the scrotum or upper scrotum is satisfactory. If the not stated cases

are also excluded the result would be considered satisfactory in 60 per cent of the cases. The authors consider that 50 per cent of the end results were satisfactory.

In this same series the size of the testicle after operation was as follows:

| S | C |
|--------------|-----|
| Not traced | 10 |
| Not stated | 8 |
| Not palpable | 13 |
| Atrophic | 47 |
| Normal | 29 |
| Total | 537 |

According to these figures in the total series 7 per cent of the testicles were of normal size after operation. If the not traced and not stated cases are excluded 31 per cent of the testicles were normal in size. Probably 15 per cent might be considered as an approximately true proportion.

In his report of the end results of 15 cases of undescended testes in which operations were performed by Bevan Disenstaedt states that in none of the ten patients who returned for follow up examination was there any evidence of hernia. In this series the position of the testis was found to be midscrotal in four cases and low scrotal in six of the cases examined after operation. An increase in the size of the testicle was noted in all cases that were traced.

Turner reported the end results in 43 cases in 70 per cent of which the transplanted testicles were well down in the scrotum.

Mixter reports a 0.5 per cent mortality. He secured satisfactory end results in from 75 to 80 per cent of his cases. The relation of the end results to the position of the testicle at operation is indicated as follows:

| S | U | T |
|----------------|----|----|
| Int abdominal | 6 | 3 |
| Inguinal canal | 38 | 7 |
| Low scrotal | 8 | 5 |
| Total | 52 | 15 |

Meyer reports 64 cases in 35 of which the post operative records were followed. In all the follow up examinations of these cases the testicle was found to be well down in the scrotum, no case of atrophy, retraction or hernia was reported.

Among the 31 cases in which the testicle was fixed in the scrotum Pastern reports good results in 32.6 per cent, fair results in 22.58 per cent and poor results in 45.16 per cent of the cases. On the other hand operation by fixing the tes-

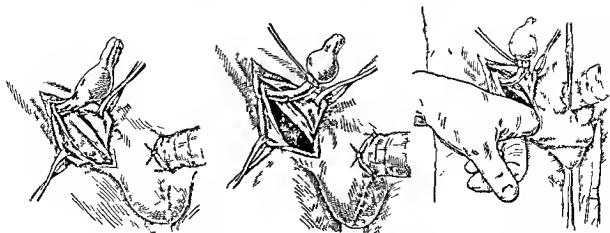


Fig 1. The testis is pulled down from the upper thigh. Fig 2. The testis is pulled down from the inguinal region. Fig 3. The testis is manipulated by the hand.

Fig 3. The testis is manipulated by the hand.

testicle in the upper thigh gave the following results in a series of ten cases in 70 per cent good results in 10 per cent fair and in 20 per cent poor. In the former group the testicle showed development in 100 per cent of the cases whereas in the latter development occurred in 60 per cent.

SURGICAL TREATMENT

Unilateral ectopy. An operative procedure on an ectopic testicle may be considered ideal if the integrity of the gland is not sacrificed by gangrene or atrophy and if the testicle is made to occupy the base of the scrotum without tension or discomfort.

Walther has emphasized the value of utilizing the elastic septum of the scrotum whereas in his series Ombredanne performs a transscrotal orchid

opexy. He has used this operation for 20 years and in many hundreds of cases.

Lowering of the testicle which at times necessitates the division of the spermatic artery and because of other complications compromises the integrity of the gland is unnecessary with the technique of Ombredanne as in it the septum is brought up to the testicle. Because of the elasticity of the septum the testicle will be found in its normal position within 3 or 4 weeks after the operation.

Ombredanne's technique. The usual incision for inguinal hernia is made and the anterior wall of the inguinal canal is incised. The cord is then exposed and isolated. The mobility of the testicle may be found to be impaired by a fibro-adipose mass of tissue which tends to draw it in the direction of the bottom of the scrotum. In this mass a peritoneal vaginal cul-de-sac may be found which may contain the unrolled epididymis; therefore extreme caution must be exerted to free the bottom of the cul-de-sac without cutting the epididymis or the vas deferens. By gentle dissection the lower extremity of the gland is freed from the adjacent tissue (Fig 1).

The peritoneal vaginal canal is then explored. It is usually patent a condition which may explain the association of an undescended testis with hernia. A radical operation for hernia should be performed at this stage. If the canal is unoccupied by a hernia obliteration of the canal is unnecessary as it will close spontaneously after operation when the wall of the inguinal canal has been restored in front of it. However if we find that the cord is shortened then by transverse division of the serous peritoneal vaginal canal and retraction



Fig 4. The testis is pulled down from the inguinal region into the scrotum. The elastic septum of the scrotum is utilized.



Fig 5 Fifth step traction suture is grasped by hemostat in order to draw testicle into place

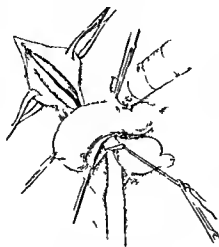


Fig 6 Sixth step testicle has been drawn through the septum by means of the traction suture

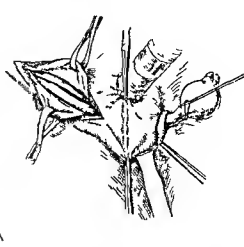


Fig 7 The seventh step consists in the partial closure of the opening through the septum

of one half of it upward and the other half downward additional length may be secured which facilitates lowering of the testicle

A sliding knot is then placed above the gland (Fig 2) and the testicle is covered with a warm moist compress

The scrotal raphe is marked with two Kocher clamps and held gently Then with the left index finger beginning at the inguinal incision a passage is made into the scrotum progressing toward the middle of the sac diagonally opposite (Fig 3) Blunt curved scissors may be of aid in the making of this tunnel

When the elastic septum is reached it is forced back and the integument of the scrotum on the opposite side is raised In a case of bilateral ectopy no obstacle will be met if the ectopy is unilateral if for example the left testicle occupies a normal position and an orchidopexy of the right testicle is being performed care must be taken that the finger used in making the tunnel elevates the left testicle and presents to the edge of the scalpel only the scrotal integument which overlies the elastic septum of the scrotum On the side of the scrotum elevated by the index finger a vertical incision approximately 3 centimeters in length is then made The incision includes the whole thickness of the integument

The septum then becomes visible being recognized by its white color By means of a compress the two cutaneous lips are pushed back along the finger which is pushing the septum in the inverse direction By this procedure separation is accomplished and a place for the testicle is secured

Next the septum which has been elevated by the index finger is pushed back and grasped above

and below by two Kocher clamps The septum is incised vertically between the clamps thus making it possible for the finger to pass through the septum In this way a transscrotal passage has been formed from the right inguinal incision to the left scrotal incision A Kocher forceps is clipped to the tip of the finger (Fig 4) and the latter is slowly withdrawn the forceps being drawn with it through the inguinal incision The free ends of the catgut the slip knot of which has been placed around the neck of the gland are now grasped with the clamp of the forceps (Fig 5) and brought through the opening in the septum

If the cord and deferens are sufficiently long the testicle can easily be brought through the opening which has been made in the septum of the scrotum If they are too short and the testicle cannot be brought down to the opening in the septum the opening in the septum must be elevated to the testicle (Fig 6) This technique of

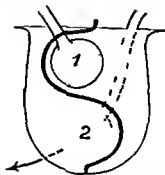


Fig 8 Bilateral transscrotal orchidopexy (Ombredanne) Schematic drawing showing relative positions of (1) the testicle which has been lowered into the scrotum in the first operation and (2) the testicle which is being lowered in the second operation

bringing the septum up to the testicle always renders orchidopexy possible. It is the chief advantage of the transscrotal or Ombredanne technique.

The opening in the septum should be closed next. Care must be exercised here to make this closure sufficiently tight to prevent escape of the testicle, but not tight enough to cause strangulation. The cord is forced back in the upper commissure of the incision and a suture of linen is placed below it and secured all the way down to the lower part of the button-hole incision, thus assuring hæmostasis (Fig 7). Ombredanne does not advise catgut as it may absorb too rapidly and allow the testicle to escape. Traction on the testicular suture will show whether or not the cord moves freely through the remaining opening in the septum and traction on the cord in the inguinal canal will make certain that the testicle cannot escape through the opening in the septum. The traction suture about the testicle is then removed by releasing the slip knot and the opening into the scrotum is closed.

All that remains to complete the operation is the restoration of the inguinal canal as it is done in the operation for hernia. As the ectopic testicle which has been thus fixed below the normal testicle tends to rise the elastic septum deviates to one side and the testicle occupies a position beside the normal testicle.

Bilateral ectopy. It is seldom advisable to perform a bilateral transscrotal orchidectomy in a one stage operation by the Ombredanne technique although Ombredanne occasionally advises it if there is an ectopic testicle on one side and a floating testicle on the opposite side or in a case of two floating testicles. Usually however there is danger in performing a simultaneous bilateral orchidopexy even by Ombredanne's technique for a band may be produced by the crossing of the cords below the root of the penis with resultant difficulty in urination because of pressure on the urethra. For this reason Ombredanne advises the unilateral operation as a general rule.

In a case of bilateral undescended testicles the more difficult side is operated upon first. When the second operation is performed about 3 months later it is astonishing to see how the testicle which has already been operated upon has increased in size in comparison with the opposite undescended testicle. In this second operation it is necessary to pass below the testicle previously fixed for at that point the septum can be more easily drawn up about a testicle which occupies a high position (Fig 8).

Usually no difficulty is encountered at the second operation. Occasionally however some

difficulty arises when one tries to separate the scrotum from the lower plane in an attempt to secure a cutaneous opening for the testicle. According to Ombredanne's statement a sufficient opening can be obtained if the cellular layer is separated gently with curved scissors. In these bilateral cases a short time after the second operation the testicles are found to be at the same level especially if the cords are of approximately the same length.

The notable features of Ombredanne's technique are the following: (1) no interference with the blood supply of the cord and of the testis is necessary; (2) if the testicle cannot be placed in the base of the scrotum the septum can be brought up about the testicle the elasticity of the septum tending within a few weeks to bring the testicle to the base of the scrotum; (3) the septum is the best agent whereby to fix the testicle in the scrotum after it has been brought down into it.

RESULTS

Ombredanne and his assistants have operated on nearly 900 cases with this technique. Immediately after operation an increase in the size of the testicle is to be noticed. This increase is partially to be explained by the swelling of the tissues surrounding the testicle but after 3 months the inflammatory condition will have subsided and the size of the testicle itself can be well discerned. In some cases its enlargement is surprising. In cases of bilateral ectopy in which operation is always first performed on the smaller testicle when the patient comes back 3 months later to have the second operation the first smaller testicle which is now in the scrotum is very often found to be the larger. This is always very convincing proof of the efficacy of the treatment and the parents are very much encouraged.

Of course such excellent results are not obtained in all cases. Sometimes when the testicle is not found before operation it is not possible to find it at operation or some yellow tissue may be the only sign of its presence. But in such a case a splendid iliac gland may be present with a fairly long cord waiting before the closed door of the inguinal canal. With Ombredanne's technique it is easy to fix such a testicle in the scrotum.

In other cases the testicle may be found before operation but it may not have the tenderness which is characteristic of the testicle. Froelich's syndrome may be present and at operation one may find only a very small soft testicle. Too often such a testicle will not grow after operation. In these cases also one has to deal with a general aplasia and very little elastic tissue is present in

the undeveloped septum. The septum will also distend secondarily allowing the testicle to reascend to a certain extent. Sometimes however if the ectopy is bilateral after operation on the second side the second testicle will pull the first testicle down again by means of the septum so that one may have agreeable surprises in these cases. In any event Ombredanne's technique seems to be the surest method to prevent recurrence and to secure a good development of the testicle.

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CARCINOMA OF THE MALE URETHRA

WITH A TECHNIQUE OF PENIS EXTIRPATION¹

C. B. HUGGINS, M.D., AND GEORGE M. CURTIS, M.D., CHICAGO

From the Department of Surgery, University of Chicago

THE occasional occurrence of carcinoma associated with periurethral abscess and similar misleading secondary clinical syndromes again needs emphasis. We should attempt to diagnose earlier this rare neoplasm which is particularly suitable to surgical attack owing to its low degree of malignancy. The discrete local growth, the lateness and rarity of metastases together with the ease of local removal due to the surrounding anatomical structures, such that resection gives a high proportion of favorable results except in advanced and unusual cases. The tumor is analogous in its course to bladder carcinoma although it is more suitable to resection than are most of those tumors. The difficulties encountered with this tumor are mainly those of diagnosis. It is a characteristic tendency of this neoplasm to contract the urethra and to become secondarily infected. In the routine manner of the clinic the insidious carcinomatous background may be completely overlooked in the treatment of the periurethral abscess and the cancerous stricture.

FREQUENCY

Robb was unable to find a specimen in the museums of the Royal Colleges of Surgeon in London and Edinburgh.

Thiuriere published the first case in 1834. In 1907 Preiswerk collected 42 cases in the first comprehensive review of this subject omitting however several cases. Since then valuable articles have appeared by Rizzi, Amadeo, Christen, O'Neil, Kretschmer and Culver and Forster. In a survey of the literature we have been able to find 110 cases on record excluding doubtful ones such as those reported in Thomson Walker's text book (insufficient evidence) and those cases of prostatic carcinoma, carcinoma of the penis and epithelioma developing in fistulous tracts reported in the literature as carcinoma of urethra.

The majority of cases occurred in patients in the cancerous sixth and seventh decades. Paton's case however occurred in a boy of 18. Hutchinson in a man of and Kroiss in a man of 91.

ETIOLOGY

The exact stimulus for lawless tissue proliferation is at the present time unknown. Many predisposing factors have been described in connection with this particular tumor of the urethra and as many theories of etiology. Aside from the classic theories of Cohnheim and Virchow regarding tumors in general gonorrhoea and trauma are most frequently accused. In Rizzi's statistics of 5 cases a previous gonorrhoea was found in 60 per cent and trauma in 10 per cent. Of Tanaka's 65 cases 26 had gonorrhoea. Christen encountered a history of gonorrhoea five times in 8 cases. Bierbaum, Tizon, Amadeo and others emphasize this factor. Probable gonorrheal structure of the urethra has been described in many cases by Lavanant, Hall, Cabot, Witzenhausen and others—and traumatic stricture in the cases of Hutchinson etc. Undoubted origin in a gonorrheal stricture is reported by Robb, Wassermann, Gayet, Lipman, Wulf and Platte. They emphasize the origin of carcinoma in the dilatation of these strictures rather than in the stricture *per se*. Thus the frequent relation of carcinoma to stricture is noteworthy, but the incidence of urethral neoplasm in the strictured and in those with a past history of gonorrhoea is certainly very small, strongly suggesting additional factors of greater importance.

In Kretschmer's and Grunfeld's cases papilloma had previously been removed from the urethra. Shattock was inclined to regard arsenic medication as an etiological factor and in Kretschmer's case symptoms developed rapidly following the use of Hartzell's (iodine glycerine) fluid. Culver and Forster's case was scalded by steam. In the case of Olivier and Clunet, sex perversion was a possible factor and in that of Soubeyran the insertion of straws into the urethra. The majority of German authors consider the irritative action of chronic urinary infection an important factor.

PATHOLOGY

The usual lesion is the squamous celled carcinoma with typical pearly body keratinization. This type occurred in 55 cases of Kretschmer's collection of 80. Columnar celled carcinoma has been reported by Cabot, papillary carcinoma has been described by Buday, Shattock, Englisch and Kretschmer, adenocarcinoma by Olivier and Clunet. The frequency of urethral squamous celled carcinoma is due probably either to a metaplasia or to embryonal cell nest inclusions.

¹Th. K. H. C. O. J. L. I. G. F. M. B. D. L. S. M. H. F. L. S. F. M. D. C. L. R. H. F. H. L. Y. F. C. H. R. I.
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since stratified squamous epithelium in the urethra is normally limited to the fossa navicularis. The epithelium covering old strictures is almost always cornified stratified squamous epithelium and has been studied by Cedercreutz, Posner and Halle who regard it as due to a metaplasia. This epidermidization of strictures is explained by Hubner however as due to development through infection and irritation of embryonal nest of squamous epithelium which he describes as existing in the urethra.

The neoplasm is situated more commonly in the penile and membranous urethra than in the perineal. Legueu cites the incidence in the penile as 63 per cent, Rizzi as 47 per cent. In Romano's case the tumor which he reports as having arisen in a gland of Littre was connected to the urethra by a narrow stalk.

The tumor metastasizes late in its course usually to the inguinal glands. In Allenbach's case it metastasized to iliac glands around the left ureter to the lungs and liver. Necropsy in Paul's case revealed that the growth was limited to the perineum and neighboring glands. In Montgomery's case necropsy revealed involved pelvic and lumbar glands but no other secondary metastases. In Guiard's case secondary nodules were found in the lung. No metastases were found in the cases of Amadeo and Griffiths. Death has usually been due to urosepsis.

SYMPTOMATOLOGY

The clinical syndrome varies depending upon whether the tumor is located in the perineal or penile urethra. Difficulty on urination and infection are common to both forms and are usually present. Hemorrhage is not infrequent.

Penile. The difficulty on urination is of all grades of severity including complete retention (Deveze Bonzani). The penis swells in size (Hutchinson Scott and others) and may be cyanotic (Bonzani). Priapism is not infrequent (Olivier and Clunet). Abscess (Conforti) and fistulae (Menard Bonzani and Menocal) are not so common as in the perineal form. A bloody cyst on the under surface of the penis has been described. Pain in the penis may be great (Scott) or absent (Bonzani). The growth may be seen protruding from the meatus (Menard Deveze Rizzi Olivier and Clunet and Tizon) and the tumor is usually easily palpable (Hutchinson Olivier and Clunet Ottow Bonzani Hall Rizzi Culver and Forster). Urethrorrhagia and hæmaturia are common symptoms (Soubeiran Shattock Rizzi Menocal). Purulent urethral discharge may occur (Ottow O Neil Shattock).



Fig. 1. Gross specimen of amputated penis showing the carcinoma at C destroying the tunica albuginea and invading the corpus cavernosum. Dorsal surface above.

Perineal. The most striking feature of the tumor in this location is the frequency of its association with periurethral abscess. Case after case in the literature reads as follows: gonococcus urethritis later difficulty stricture periurethral abscess drainage fistula biopsy radical surgery and cure. Apparently the periurethral abscess is temporarily a successful disguise for this tumor and an examination of tissue from the abscess wall is not always a routine procedure. The abscess cavity may be filled with blood or friable tissue. The tumor can rarely be felt in the perineum (Amadeo Montgomery Romano and Paton). Urinary infiltration in the perineum was observed by Hall. Severe priapism was observed by Allenbach and O Neil. Acute retention was seen by Lavanant Barney O Neil and others. Hemorrhage between urinations as well as hæmaturia is noted by Guyon and many others. A marked oedema of the scrotum and perineum developed in a week in the case of Michon.

THERAPY

Radical surgery should be considered except in cases with hopeless infiltration since metastasis is rare and late.

For lesions in the anterior third of the urethra simple amputation of the penis should suffice. For urethral carcinoma between this point and the membranous urethra more extensive removal of the penis with penile implantation of the urethra is indicated. For cavernous lesions the entire penis with the crura and urethra down to the membranous urethra should be excised. Emasculation has been frequently performed by European surgeons but no evidence of the involvement of the testes is available in any of the reported cases and we believe that it is an unnecessary procedure. In the case of Braasch and Scholl the urethra was excised and later replaced by a transplant of a section of the saphenous vein with satisfactory results.



Fig. 4. Histological section showing dense cellular structure, likely a histological section of tissue.

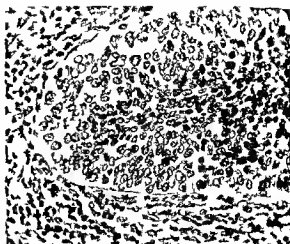


Fig. 5. Histological section showing dense cellular structure, likely a histological section of tissue.

Inguinal gland if involved should be dealt with urgently. Heavy postoperative irradiation of the perineum and the adjacent tissues seems to be indicated in the present state of our knowledge.

COMPLETE EXTIRPATION

The chief difficulty in the operation of total or subtotal removal of the penis lies in the control of hemorrhage from the erectile tissues and the subsequent identification of the urethra. To minimize this factor we have applied several simple measures which briefly described are:

As in the common practice two incisions are made in longitudinal in the perineum. The other circular around the root of the penis. The transverse perineal muscles are identified. An aneurism needle is then passed between the pubic ramus and the crus penis on each side anterior to the transverse perineal muscle and the crus is doubly ligated and cut (Fig. 4). If the crus is ligated posterior to this point incontinence from nerve injury may follow. A woven filiform is then inserted in the urethra for identification. The bulbocavernosus muscle is split at the decussation of its fibers. The finger may then be easily passed inside this muscle and between the superficial layer of the triangular ligament and the bulb (Fig. 5). Two heavy ligatures are tied around the urethra at the elected point of section and the urethra and filiform are cut. The crura and penis may be easily removed through the anterior incision. After the urethra is identified the filiform is removed. Hemostats are so placed as to include the vascular bulb as a whole and the ligature around the proximal part of the bulb is removed. The erectile tissue may be easily dis-

sected away and the urethra dealt with suitably. The wound is drained and a catheter *a demeure* is applied.

PROGNOSIS

In Hutchinson's case a slight recurrence followed months after simple amputation however the patient was well at least 8 months following simple fulguration. Scott's case was well 10 months after operation. Lippman Wolf's patient died in an accident 3 years and 9 months after operation. Oberlander's case showed recurrence in the prostatic urethra in 4 years. Braasch and Scholl's case was alive 5 years after operation cure not known. Culver and Forster's case was well 6 months after operation. Rizzuto reports that 16 of 35 cases operated radically were well 6 months or more after operation. Kretschmer's report 2 years after operation does not mention recurrence.

CASE REPORT

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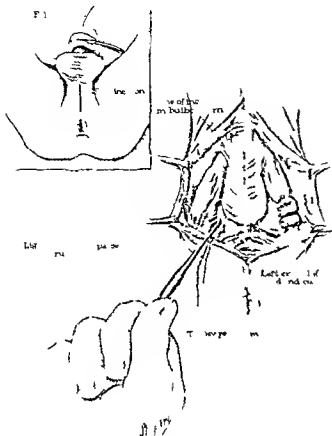


Fig. 4. Preliminary hemostasis by ligation of the crura anterior to the transverse perineal muscles

the posterior part of the cavernous urethra extending into the perineum. The skin was freely movable over the mass which was not red. A pea-sized painless lymph gland was palpable in both inguinal regions. The rectal examination was negative. There was a stricture of the urethra opposite the mass admitting only a No. 6 French bougie. There was a mild generalized arteriosclerosis. Other vascular examination was negative. The urine contained much pus and a trace of albumin. The Wassermann reaction was negative. The patient was admitted to the Albert Merritt Bldg. Memorial Hospital where a needle was inserted into the mass and yellow pus was obtained for culture and microscopic examination. Bacteriologically the pus showed streptococcus viridans and staphylococcus aureus. Drainage of the abscess the next morning was not followed by the usual resolution of the inflammation. Instead the mass grew rapidly. Heat was applied to aid resolution of the infection. Three days later urethrosopic examination showed red elevated masses resembling granulation tissue at the site of the stricture. No biopsy was made at that time. Three days later biopsy was decided upon and a egg-sized mass of tissue was removed through the perineal wound. Examination of this tissue showed various stages of inflammation. Further local treatment of the infection was carried out for weeks when a second biopsy including this time the urethral mucosa showed carcinoma. Radical extirpation of the penis with section of the urethra 1 centimeter anterior to the triangular ligament was followed by uneventful recovery. The patient was discharged from the hospital 20 days after operation. At this time 11 months later the patient is symptom free, has gained 35 pounds and works daily.

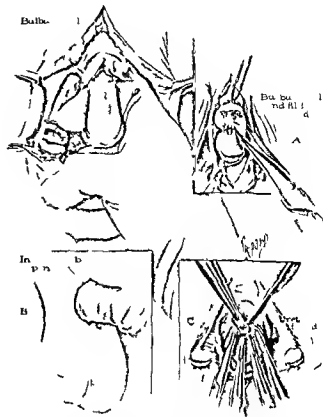


Fig. 5. The cleavage plane between the urethral bulb and the superficial layer of the triangular ligament is shown. Inset A shows the procedure in ligation of the bulb with subsequent section of the erectile tissue and filiform. Inset B hemostats are applied to the corpus spongiosum. The proximal end of the filiform has been withdrawn and the urethra is being dissected prior to perineal implantation. The penis is removed through the circular incision in B.

PATHOLOGY

Grossly the carcinoma consists of an irregularly ovoid indurated mass measuring about 4 by 3 by 3 centimeters. It arises from the dorsum of the posterior portion of the cavernous urethra, invades the corpus spongiosum and destroying the tunica albuginea of the overlying corpora cavernosa extends into the erectile tissue (Fig. 1). The mass extends posteriorly into the region of the urethral bulb and perineum. This portion is nodular and within it are multiple abscesses containing a thin greenish pus. The indurated mass completely surrounds the intact urethra. The urethral mucosa is slightly hemorrhagic and presents no evidence of stricture. In cut section the carcinoma is cartilaginous in consistency, granular in appearance and of a grayish color.

Microscopically the sections reveal a squamous celled carcinoma with a moderate amount of keratinization and some epithelial pearl formation. There is a severe surrounding inflammatory

reaction including acute abscess formation. The urethral epithelium in the involved region is thickened and sends many papillary processes down into the underlying submucosa (Fig. 1). Many of these have an intact basement membrane (Fig. 1) but others have none and isolated cells and cords of cells are seen extending into the adjacent submucosa. Many of the folded processes may have a core of vascular connective tissue (Fig. 2) even desquamated cells and necrotic tissue. Throughout the sections reveal a severe inflammatory reaction of varying degrees and stages. The submucosa of the adjacent urethra is edematous and is aided by leucocytes. The inflammatory and carcinomatous process involves the erectile tissue of the corpus spongiosum, the tunica albuginea and the erectile tissue of the corpus cavernosum.

SUMMARY

This case demonstrates the following important points: (1) that the course of the lesion is indolent; (2) that urethral carcinoma can cause periurethral abscess and stricture which are clinically indistinguishable from the usual variety of primary type; (3) that biopsy to be effective in the diagnosis must include urethral mucosa; (4) that an apparently good result has been obtained from radical surgery.

It demonstrates that biopsy by means of the urethroscope should have been carried out and suggests since the pathology is mucosal endoscopic removal of tissue in similar suspected cases. Urethroscope findings have been reported by Grunfeld, Christen and Oberlander.

CONCLUSIONS

1. Carcinoma is associated with a small percentage of periurethral abscesses and urethral strictures.

2. Urethral carcinoma is rather low in the scale of malignancy and is well adapted to surgical treatment.

Biopsy which should include the urethral mucosa is the only certain method of diagnosis.

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FASCIA LAPPING AS APPLIED TO THE TISSUES OF THE VAGINAL WALL—A MISNOMER

DOUGLAS BISSELL, M.D., I.A.C.S., NEW YORK.
C h r e s t i a n M e d i c a l S c i e n c e S c h o o l

LAPPING of the tissues of the anterior vaginal wall for the correction of cystocele and prolapse of the uterus has engaged the attention of gynecologists for the past 11 years. My interest in this field began at its inception and it was my impression in common with others then that there existed in the tissues used a definite layer of fascia which was derived from the intra-abdominal fascia. The technique which I adopted differed from others however in that it did not aim to utilize this fascial layer as a separate entity but to use it undisturbed with all the other structures of the anterior vaginal wall. The initial step and one of the essential features of my technique is a direct transverse incision of the anterior wall immediately above the cervix into a cellular area bounded by the cervix, bladder and anterior wall. I found in following this procedure that this cellular area is a well defined space in which the bladder, cervix and anterior wall are but loosely connected and that when a definite cystocele exists this loose connection extends to the base of the urethra and in case the cystocele is extensive this loose connection is found to extend laterally also.

In that my previous studies of the fascial relationship in the pelvis led me to believe that the visceral layer a ramification of the intra-abdominal fascia delved down between the bladder and the anterior vaginal wall. I concluded that the superior surface of the separated anterior vaginal wall constituted in cases of cystocele the visceral fascial layer and that when this pathological condition existed the visceral layer lost its intimate relationship with the bladder wall and remained an intricate part of the anterior vaginal wall. Eight years ago I doubted the correctness of this idea and began a series of studies of the tissues removed during the course of my operations for all forms of vaginal prolapse. These studies have convinced me that the tissue which I have been considering fascia is not fascia or if fascia it has undergone some pathologic change and as found could render when isolated whether doubled or quadrupled no serviceable support if used in the process of reconstruction for correcting any form of vaginal prolapse.

Figure 1 is a drawing of a piece of tissue (1½ by 3 inches) removed from the left side of the freed longitudinally and medianly incised anterior vag-

inal wall. This piece of tissue was removed during an operation to reconstruct the anterior vaginal wall for the cure of a very large cystocele and shows the characteristic smooth under surface. The lower border was severed from the region of the cervix. The right border represents the line of the median longitudinal incision. The left border represents the line of incision which severed this section of the wall from its lateral attachments. The remaining lateral portion of the vaginal tissue on this side was eventually used as the overlapping tissue in the formation of a supporting shelf for the bladder. The apex of the triangle represents the region at the base of the urethra.

Figure 2 is made from a microscopic study of a cross section of the tissue through its center seen in Figure 1. This structure consists chiefly of the muscle fibers of the vaginal tube, blood vessels



Fig. Tissue removed from anterior vaginal wall



and loose connective tissue with mucous membrane and cellular tissue above no fascial layer is demonstrable

Figure 1 is made from a microscopic study of the cross section of the corresponding piece of tissue shown in Figure 1. The part on the right side from which the mucosa and submucosa have been removed represents the tissue which is utilized to form the under flap when the shelf upon which the bladder is to be supported is constructed. This piece of tissue also consists chiefly of muscle structure and blood vessels in which no fascial layer can be demonstrated and upon it the entire muscle tissue of the vaginal tube on the opposite side is placed and anchored doubly to strengthen the support created for the bladder. These are two of 25 or more studies I have made of different cases. It might be here incidentally noted that the posterior and anterior vaginal walls are structurally the same.

CONCLUSIONS

In cases of vaginal prolapse there is no definite fascial layer of the vaginal wall which can be isolated and used surgically to advantage.



Figure 2 is made from a microscopic study of the cross section of the corresponding piece of tissue shown in Figure 2. The part on the right side from which the mucosa and submucosa have been removed represents the tissue which is utilized to form the under flap when the shelf upon which the bladder is to be supported is constructed. This piece of tissue also consists chiefly of muscle structure and blood vessels in which no fascial layer can be demonstrated and upon it the entire muscle tissue of the vaginal tube on the opposite side is placed and anchored doubly to strengthen the support created for the bladder. These are two of 25 or more studies I have made of different cases. It might be here incidentally noted that the posterior and anterior vaginal walls are structurally the same.

The musculature of the vaginal tube constitutes the chief resisting tissue of the tube.

The strength of the normal vesicovaginal septum consists of the intimate union of the muscle tissue of the walls of the vagina and the walls of the bladder.

To correct a cystocele the anterior vaginal wall must be completely separated from the bladder so that a new union can be established between the musculatures of these walls and so that the vaginal wall will be doubly strengthened by the lapping of its musculature.

As there is no definite fascial layer demonstrable in the vaginal structure lapped the term fascial lapping is a misnomer.

As a corollary the etiology of cystocele is the loss of complete and intimate muscle union of the bladder and vaginal wall in this loss of union each structure is compelled to resist separately and in so doing fails to maintain its normal position.

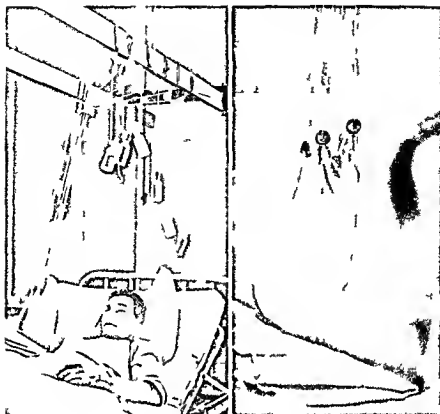


Fig (left) Method of treatment of the patient
 (right) Close-up of the surgical procedure



Fig 4. Apparatus for the treatment of the patient
 (left) Close-up of the apparatus

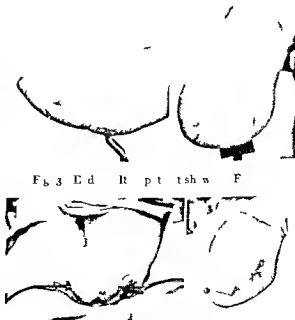


Fig 3. End of the treatment of the patient

Fig 5. Diagram of the surgical procedure



Fig 8



Fig 9



Fig 10



Fig 11

Fig 8 Gas bacillus infection of the left shoulder blade wound. The wound left after incision and drainage.

Fig 9 and 10 Same patient showing sutures in place and end result.

Irrigation of the wound with Dakin's solution is carried out every 2 hours instead of the usual 4 hours and is continued to the last minute. The skin edges are very carefully cleansed with benzene and then with alcohol or with soap and water and then alcohol. Any secretions are then washed from the wound with sterile salt solution or blotted off with dry gauze. Frequently we wash the entire wound and surrounding skin by pouring either over it. The skin edges are painted with tincture of iodine. For small wounds local anesthesia is used for larger ones gas or ethylene. The edges of the skin are then freshened by cutting away the thin margin of new epithelium. Undermining of the skin edges is used only if necessary and every care is taken to avoid traumatism to the granulating surfaces. Bleeding is controlled by hot packs if possible for it is unwise to bury much ligature material. The closure is then made by the placing of interrupted deep sutures of silk worm gut or of silk and tying them loosely. These are usually placed 2 to 2.5 centimeters apart so as to allow for drainage between them for drains are seldom necessary or desirable. The skin approximation must not be too exact because provision must be made for some escape of exudate between the sutures. The cleaner the wound the more exactly may the skin be closed.

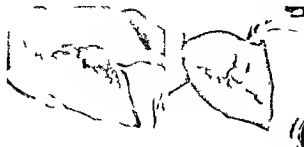
Of great value in providing closure without undue tension on the skin is a planned procedure in the original operation. For example in amputations when the level can be elected a cuff of skin or anterior and posterior flaps can be reflected and sutured to the skin above in their reversed position. This gives a wound easy to dress and prevents excessive contraction of the skin. In guillotine amputations or in other wounds in which insufficient skin is present more may be made available by the use of traction. Various

forms of obtaining and maintaining traction have been devised but our most satisfactory results have been with weight and pulley traction applied directly to the skin by means of wire sutures placed in its edge. These sutures are given a broader bearing surface when the ends of the wires are tied to ordinary bone buttons which are allowed to pull on the skin. The best weights we have found are small bottles which can be filled with water or with lead shot to give the



Fig 12 (left) Amputation for severe infection of the wing. (right) Reduction of compound fracture.

Fig 12 End result in patient shown in Figure 11.



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The average time between the last operation and the time of closure in 42 of the 49 cases was 13 1 days. The 7 cases excluded are 3 cases of chronic empyema, 2 cases of chronic osteomyelitis, 1 case postponed for more than a month because of poor physical condition, and 1 case in which the time was not recorded.

CONCLUSIONS

1. Secondary closure is a valuable procedure.
2. The procedure is not used as extensively as it should be.
3. It is of particular value in certain types of cases: (a) traumatic amputations, (b) amputations for severe infection, (c) for closing infected wounds and abscess cavities.
4. The procedure gives better functional results than does skin grafting.

HÆMANGIOMA OF KIDNEY

HAROLD H. CHILDS, M.D., NEW YORK.
 71 St. U. 111, N.Y. 100.

A RECENT report by Judd of a case of angioma of the kidney recalled to us a patient who was operated upon at the Presbyterian Hospital for a similar condition and whom we have followed for 10 years since his operation. The fact that Judd found only eleven reported cases seems to warrant the addition of this one to the literature. It is the only case of hæmangioma in the records of the Presbyterian Hospital. The symptomatology was that which would be expected in a bleeding renal neoplasm. The diagnosis of kidney tumor was made by the usual urologic methods. The treatment which in this patient resulted in cure was nephrectomy.

History. No. 39,64. A young married Jewish peddler aged 37 years entered the hospital September 23, 1913, complaining of pain in the back and right side and blood in the urine. He had had typhoid fever at 10 years of age and malaria at 30. He was well until 9 months before admission when after doing some heavy lifting he was suddenly seized with a sharp stabbing pain in the right lumbar region which radiated to the right testicle and the inguinal region. Three hours later he passed a large amount of bloody urine with some clots. He continued to show blood in the urine for 3 or 4 days. He remained in bed for 9 days when he again passed bloody urine but this time the redness associated with attack of pain. From then until his admission he had several attacks of hæmaturia of all sorts of duration.

Physical examination revealed a round slightly tender mass in the right upper quadrant of the abdomen which moved on respiration. X-ray examination of the kidney gave a negative result. Cystoscopic examination showed a normal bladder except for several blood clots, one of which seemed to be emerging from the right ureteral orifice. The left ureteral orifice was normal. Clear urine was obtained from the left ureter; bloody urine from the right. Both specimens were negative for tuberculosis. Pyelography which was not a routine procedure in those days was not done. Blood urea was 31 grams per litre. Blood Wassermann was negative for the alcohol antigen three plus for the cholesterol antigen.

The diagnosis of renal neoplasm was made and on October 3, 1918, right nephrectomy was done by Dr. Squier.

The kidney on gross examination was normal except for a rather adherent capsule and a slight enlargement of the entire organ with a moderate dilatation of the pelvis.

Pathological examination of the gross specimen shows a kidney 2 by 6 centimeters. Upon one surface is a smooth shiny capsule with a few fine adhesions which are representative of the most of the anterior surface. From the middle anterior portion of the anterior external surface there is a more or less lobular tumor about 6 by 6 centimeters. At three different places there are bluish elevations on the surface which appear intimately attached to kidney tissue. The tumor as a whole is cystic and slightly fluctuating. The pelvis of the kidney appears slightly dilated. The ureter appears normal. The kidney capsule strips the great ease but leaves the surface slightly granular. At several places the capsule is discolored bluish black by what appear to be old areas of hæmorrhage. Upon palpation of the pelvis



Fig. 1. Gross specimen showing kidney and tumor.

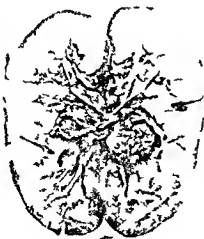


Fig. 2. Kidney bisected showing tumor in situ in pelvis.



Fig. 3. Section has been made through the tumor mass.



TUMORS OF THE PARATHYROID GLANDS

CHRISTIE C. C. M. D. (CHICAGO)

IN the last 5 years much investigative work has been done and a great many articles written on physiology and pathology of the parathyroid glands. Comparatively few articles however discuss the presence or possibility of tumors of these glands although Sandstrom who first recognized and described the parathyroids as independent organ pointed out that they could be interesting to the clinician and pathologist if they formed the matrix of tumors. Because such tumors may be confused with thyroid neoplasms and because a study of them may help to clarify our knowledge of the function of these glands it seems justifiable to report the following case and to review the literature on the subject.

A native born white woman age 39 years entered the Cook County Hospital January 9, 1916 with the admitting room diagnosis of adenoma of the thyroid. The main complaint was a swelling of the neck for 3 years. She stated that she first noticed a small lump about the size of a marble in the left side of the neck 5 years before and 6 months after giving birth to her first child. The mass gradually grown larger especially in the last 2 years but had remained localized on the left side only. At or before her menstrual period she experienced shooting pains across the neck on exertion associated with dizziness and a choking sensation. The latter symptoms had appeared on various other occasions but usually only with menstruation. She had noticed a nervous irritability in that she became easily excited and wept on slight provocation and at such times would tremble so severely that she was forced to sit down and rest. She believed that during these attacks she had a staring gaze and prominence of the eyes. For the past month or two excessive perspiration had been noticed. During the past 2 years exertion or excitement caused palpitation of the heart with dyspnea and for 1 year there had been slight dysphagia. She had been married 8 years and pregnant three times. The first pregnancy miscarried for unknown reasons the latter two resulting in normal healthy children. Her history was otherwise unimportant.

Physical examination revealed a well nourished quiet and co-operative woman with normal temperature and respiration and a regular pulse. The blood pressure was 115 systolic and diastolic. The palpable firm mass seemed lightly indented but the eye finding, vertebral x-rays normal. There was no tenderness or abnormal pulsations in the neck but in the region of the left lobe of the thyroid there was an orange sized round coarsely lobulated firm mass without tenderness or fluctuation. The right lobe of the thyroid seemed slightly enlarged. The heart orders rate and rhythm were entirely normal and there were no other noteworthy physical findings. The blood Wassermann was negative. Her basal metabolic rate was 34 degree negative. She was quite comfortable and on January 6, 1916 operated on under ether anesthesia by J. J. Lewis. He found a mass in the side of the neck behind and below the left thyroid lobe which was adherent to and compressed by it. The tumor was covered by a fibrous

capsule well demarcated from the surrounding tissue and was removed with little difficulty. Her postoperative course was unremarkable during her stay in the hospital as usually between 80 and 90. On January 15, 1916 basal metabolic rate was 1 per cent negative the wound healed nicely and she was discharged in excellent condition.

The laboratory report was as follows: This specimen consisted of an oval fairly smooth tumor mass about 8 by 4 centimeters and apparently covered by a fibrous sheath except over one surface (Fig. 1). The tissue is generally elastic and resilient and adherent to it are gray fibrous tags. Surface made by cutting revealed a yellow to gray gelatinous medullary portion 3 to 4 centimeters in diameter in the center of the tumor. This is irregularly traversed by whitish fibrous strands which extend out into the surrounding tissue in finger-like processes. One portion of the gelatinous center is definitely calcilaginous in consistency and in this is a 2 millimeter gray white nodule which is calcified. The surrounding tissue or cortex of the tumor measured from 1 to 5 centimeters in width. It is a bluish yellow to gray lobulated in portions and striated by white yellow and red streaks. Numerous cystic cavities are formed 1 to 8 millimeters in diameter are scattered throughout all portions of the tumor. The cavity is thin walled with gray or yellow linings with contents varying from a pink mucoid fluid to blood. In one large one the blood is clotted and adherent to the wall. Irregular areas of blood are present in the capsule and tumor mass in some places forming hematomata in others being more diffuse and infiltrating the hemorrhage. Small opaque bright yellow soft spots up to 2 millimeters in diameter are scattered throughout. In no place is there any tissue resembling thyroid parenchyma nor any gross evidence of colloid. The capsule where present is intact apparently of fibrous tissue and is not invaded by the tumor.

Microscopic sections stained with hematoxylin and eosin and made from the central portions of the tumor revealed a fibrous network pink staining and devoid of nuclei in the meshes of which are masses of a granular debris and hemorrhage. Here also are space about which the connective tissue is dense and hyaline and which are filled with the ghosts of erythrocytes. More peripherally nuclei appear in the stroma the above mentioned spaces are seen to be well formed blood vessels and masses of tumor tissue are recognizable. From the central core radiating processes branch out to fuse with the capsule thus separating the tumor into masses and cords which are generally well demarcated except medially where the tumor merges gradually with and seem to give rise to the central fibrous and generated structure. The tumor cells are apparently epithelial in type spindle shaped closely packed to either thick or thin elongated or pale pink cytoplasm and large dark round or oval nuclei. The nuclei are distinct and rich in chromatin but contain no nucleoli. Mitotic figures are occasionally seen. In many areas the cells are disorganized in a plural arrangement elsewhere they are in definite order (Fig. 2). In the latter areas the tumor cells tend to be more nearly oval or polygonal but occasionally they are cuboidal and form a single layer lining a narrow channel. The small epithelial ducts thus formed are either devoid of contents or contain a granular material but no blood. Another type of space seen is much larger elongated and is found in larger areas.



Fig. 3. Parathyroid tissue in capsule of primary tumor. Normal parathyroid tissue going over into tumor tissue at B. The thin-walled endothelial-lined spaces are well shown at C.

but believed that they had been gradually enlarging. Examination revealed three non-tender lumps each about 1 centimeter in diameter just beneath the skin but protruding prominently (Figs. 5 and 6). Two of these were on either side of the neck, 4 centimeters apart, equidistant from and at about the level of the thyroid cartilage. These were firm and not adherent to the skin. The left nodule extended to the deeper structure, the right freely movable. Over the medial end of the left clavicle was a smaller but similar nodule over which the skin was somewhat reddened. The scar of the operation was well healed with some minimal contracture of the tissues below. There were no other glands palpable in the neck. Her general health was excellent and there was no evidence of bone disease nor of the presence of tumor metastases. Blood calcium study revealed 8 milligrams per 100 cubic centimeters, a normal amount.

Because of the characteristic location of two of these nodules the conclusion was that these probably represented a compensatory hyperplasia of the remaining parathyroid glands following the removal of the adenoma, although the possibility of metastases from an originally malignant tumor was considered. On the assumption that we might be dealing with a patient with an abnormal demand for parathyroid secretions, she was put on desiccated parathyroid extract by mouth and told to return in 2 weeks.

On December 1 she returned and during the past 3 weeks there had occurred a definite increase in size of all three nodules. They were still freely movable but for diagnostic purposes the one over the clavicle was removed under local anesthesia. It was quite vascular, friable, gray to yellow in color and poorly desiccated in the surrounding soft tissues.

Microscopic sections stained with hematoxylin and eosin and made from this specimen revealed an entirely different picture (Figs. 7 and 8). The individual cells still bear a resemblance to those of the primary tumor but the cells are marked variation in size and shape, a chromatin content. Mitotic figures are abundant. The palisade arrangement is nowhere to be seen and the cells are growing



Fig. 4. Normal parathyroid gland from an adult male of 45 years, dying of lobular pneumonia. The chief cells are shown at A and the oxyphilic cells at B. Colloid-like spaces surrounding the parathyroid epithelium are seen at C.



Fig. 5 (left). Recurrent nodules on November 5, 1926, 11 months after the removal of the primary tumor. The scar of the operation is shown. The two upper nodules are at the sites of the previous parathyroid gland.

Fig. 6. Showing size of recurrent nodules on November 5, 1926, 11 months after the removal of the primary tumor.



Fig. 1. Parathyroid tumor, showing the characteristic cellular structure.

Fig. 2. Hyperplastic parathyroid tissue, showing the characteristic cellular structure.

The three nodules which appeared as described within a year after operation were at first thought to represent compensatory or adenomatous hyperplasia of remaining or aberrant parathyroid tissue in the neck. Thompson and Harris have studied the presence and locations of parathyroid tissue in a series of routine autopsies and whereas four main glands were usually found at the four poles of the thyroid aberrant parathyroid tissue at other sites was discovered. Millner has more recently made similar observations. While the two upper nodules were in the typical locations of the two superior glands the lower one over the clavicle was considered as a possible aberrant nodule such as have been noted by the authors and others. Against this conclusion it was argued that there were no signs of parathyroid insufficiency following the removal of the primary tumor and such signs might be expected if the patient's demand for parathyroid secretions was sufficient to cause a compensatory hyperplasia of the remaining glands.

In spite of the gross and microscopic indication of the benignity of the primary tumor and the absence of any recurrences at its site the weight of evidence warrants the conclusion that we were dealing with a primary malignant tumor of para-

There are many aspects of this case which merit discussion but no attempt will here be made to consider parathyroid functions or to review the

thyroid origin which possibly started as an adenoma and that the three nodules represent metastases.

Search of the literature reveals few references to primary malignant tumors of the parathyroid glands. Hendrick has recently reported a case of a tumor 8 by 5 by 4.5 centimeters removed surgically from a retrosternal position in a woman of 71 years. This mass was largely surrounded by thyroid tissue and there was also present a much smaller intrathyroid tumor nodule. The larger tumor was yellow, well demarcated from the thyroid and surrounding structures except it one area with fibrous septa extending into and dividing it into lobules as in our case. The smaller tumor was less than 1 centimeter in diameter and was located at the upper pole of the thyroid gland while the larger mass was in the lower pole. Histologically the tumor cells resembled parathyroid tissue and the palisade arrangement was frequently noted. Intracellular fat was demonstrated by the Sudan and osmic acid methods. In the larger mass oxyphile cells were absent, the tumor was invading the thyroid gland and there was a departure from the physiological structure with distinct proliferating centers and the formation of giant cells. For these reasons Hendrick concluded that he was dealing with a malignant tumor arising from the inferior parathyroid of this side and invading the thyroid parenchyma. He admitted that the absence of mitotic figures and of metastases spoke against this conclusion. The smaller nodule he believed to have arisen from the upper parathyroid and considered it probably an adenomatous enlargement of an intrathyroid rest rather than a metastasis from the larger tumor. There is unfortunately no record of further examination of his patient.

Fasiani reports the surgical removal of a fist-sized nodular mass in the region of the left thyroid lobe. The patient was a woman of 45 who stated that the mass had always been present but had recently and rapidly increased in size. The operation was done under local anesthesia and the patient died on the table for unexpected reasons. No autopsy was performed. The specimen was round and nodular and definite evidence of invasion of the thyroid gland was present on both gross and microscopic examination. Histologically the tumor consisted essentially of (1) cellular protoplasmic masses staining with hematoxylin and without definite cell boundaries, (2) cords and masses of larger well defined fairly clear cells and (3) cords of chromophile staining cells resembling normal parathyroid tissue. The first two types made up the bulk of the tumor and the author

believed that cells similar to these are also found in the normal parathyroid.

The case here reported is comparable to Hendrick's and Fasiani's in several respects and probably all three tumors arose from parathyroid tissue in its normal location. Histologically the three are quite similar except that I found no invasion of the thyroid gland.

In 1909 DaCosta briefly reviewed the literature on the subject of parathyroid neoplasms and added one case which is most interesting in comparison with my own. DaCosta's patient was a woman of 37 with a mass in the right side of the neck which had been present for over 6 years. It had started following an attack of tonsillitis and had grown rapidly for the last 2 years. The patient suffered from choking attacks and an irritating cough for 3 years and was thin, pallid and neurotic. The mass was overlapped by the sternocleidomastoid muscle and was smooth and firm. It was removed and the patient made an uneventful recovery. The specimen was brown, yellow, irregular and with a bulb-like softer darker walnut-sized mass inferiorly. The main mass was surrounded by a fibrous capsule and consisted microscopically of epithelial cells arranged in fairly distinct columns separated by vascular intercellular tissues. Acini lined by cuboidal cells were noted. The nuclei of the cells were spherical and rich in chromatin. Areas of recent hemorrhage and degeneration were seen and there were many bands of fibrous tissue in the tumor. The pathological diagnosis was hyperplasia or adenoma of a parathyroid gland. The most interesting feature of the case was that the patient returned 9 months later with an exactly similar mass both in size and location on the opposite side of the neck. This Dr. DaCosta refused to remove because of the danger of tetany.

This may have been an instance of compensatory hyperplasia of the remaining parathyroid tissue although a malignant growth was not excluded. The marked hyperplasia of the remaining glands if such was the case presumably resulted from the same excessive demands for parathyroid secretion which caused or was associated with the original tumor formation. That such a hyperplasia occasionally results following thyroidectomy has been observed experimentally (Aschoff) and may be due to the accidental removal of functioning parathyroid tissue.

Because of the presence of thyroid parenchyma in the capsule of our tumor the question may be raised as to whether we are dealing with a tumor of the thyroid or of a parathyroid rest instead of one developing from a normal gland. The evi-

dence is against the former conclusion inasmuch as the microscopic structure at once suggests parathyroid origin both because of the individual cell morphology and the arrangement. As far as we know no true tumors of the thyroid present this picture and in it can be demonstrated what appears to be the transition of normal parathyroid to tumor tissue. It is true that oxyphil cells are absent and this has been the case in others previously reported. This patient's symptoms on her first admission suggest a possible thyrotoxicosis but are not diagnostic in spite of the recovery following the first operation.

Aberrant parathyroid tissue or rests in the thyroid gland have been noted by Michaud, Getzowa, Erdheim and others. Langhans and Kocher reported malignant parathyroid tumors developing in the thyroid gland but Harbitz as well as Aschoff inclined to interpret these cases as tumors of the latter tissue primarily.

Kolodny recently reported a thyroid specimen removed from a woman of 68 who had symptoms of exophthalmic goiter. The gland had white well circumscribed nodules of clear large anastomosing cells containing abundant lipoidal droplets and glycogen. These he interpreted as metastases from a hypernephroma but admitted the absence of evidence of a primary tumor or of other metastases. He does not mention the possibility of these tumors having developed as adenomata from parathyroid rests in the thyroid but this seems highly probable and Hendrick goes so far as to say that Kolodny's case is the first one reported in which the evidence is apparently sufficient to make this diagnosis. Ewing mentions the similarity between hypernephroma and parathyroid rests.

That the tumor in my case might have arisen from a parathyroid rest in the thyroid cannot be denied but it had the typical location of one of the normal gland and was not apparently intimately connected with the left thyroid lobe. The incorporation of thyroid tissue in the capsule of one side can be explained by this organ being compressed and atrophied by the growing tumor. Thus a review of the literature reveals no one unquestionable case of parathyroid neoplasm developing from an intrathyroid rest although there seems to be no histogenetic reason why this can not occur.

In attempting to collect the reported cases of true tumors of the parathyroid glands one is impressed by the frequency with which this diagnosis has been made on insufficient evidence. It is also difficult to separate the true tumors from the cases in which the enlargement of the parathyroids is so

small and uniform that it seems probable that a hyperplasia only existed. Of the latter some of the cases discussed in the papers of Strada, Todyo and Hohlbaum, Weichselbaum, Molneus and Harbitz may be mentioned. Some of these enlargements were associated with paralysis agitata, rickets, osteomalacia and osteoporosis but the significance of parathyroid changes in these diseases is doubted by Molneus and Harbitz.

There have been described however several undoubted cases in which a parathyroid gland enlargement was found which must be interpreted as true adenoma formation. One such instance of adenoma of the parathyroid removed by operation has been reported. Benjamins in 1902 described the successful removal of a tumor the size of a child's head which had grown rapidly in a man of 57. The mass was surrounded by a capsule in which normal parathyroid gland tissue was found. Microscopically the substance consisted of broad strands and masses of epithelial cells like those of the normal parathyroid. Toward the connective tissue stroma were palisade rows of cells and occasional colloid droplets were seen. There were no metastases from the tumor and the patient recovered.

In 1908 Thompson and Harris described a large tumor 15 by 10 by 6 centimeters which weighed 250 grams and was surgically removed from a woman of 2. It had been growing since infancy and involved both lobes of the thyroid. It was encapsulated and firm, the capsule dipping down between nodules up to 4 centimeters in diameter. There were a few gelatinous cysts. Histologically the cells resembled parathyroid tissue lying in nests and cords and generally cuboidal or columnar. In some areas the cell lined simple ducts which became dilated to form cysts. The blood supply was good but large blood vessels were absent. A fact the authors particularly emphasized. They came to no definite diagnosis in this case simply referring to it as a parathyroid like tumor.

Goris in 1905 made the diagnosis of cystic degeneration of a parathyroid gland on a tumor removed from the neck of a 2 year old male. It was composed of three cysts closely connected but independent and without attachment to the thyroid. Microscopically it revealed encapsulated colloid and degenerated parathyroid tissue.

De Santi in 1900 reported a large vascular tumor of the thyroid (?) removed at operation from a man of 58. The description is inadequate and all that is mentioned is that there were pressure symptoms of dysphagia, hoarseness and cough and that the gland was found microscopically to

consist of parathyroid tissue. None of the above mentioned tumors reported by Thompson and Harris Goris and De Santi can be unquestionably accepted as parathyroid neoplasms.

Adenomatous of the parathyroids have been an incidental finding at autopsy in several instances. MacCallum in 1905 described a tumor mass centimeters in diameter removed from the neck of a man of 26 who died from nephritis. This was below but separated from the lower pole of the thyroid. Microscopically it showed strands and anastomosing branches of clear cells containing no granules. Small groups of cells taking a deep eosin stain and resembling the normal oxyphile cells were seen also. It differed from the normal gland only in bulk, size of cell masses, formation of cavities and absence of fat. Two other normal parathyroids were found so MacCallum concluded that this was probably an adenomatous new growth. If however it represented a work hypertrophy he explained it on the basis of renal insufficiency making extra demands on the parathyroids although he did not elaborate on this hypothesis.

Hulst also in 1905 reported the postmortem findings in the body of an old man who died of accident. The thyroid was atrophic and on the right side was a brown yellow encapsulated tumor of a parathyroid gland measuring 2.5 by 2.5 by 2 centimeters. Histologically it consisted of nests of polygonal cells and the palisade arrangement was noticeable in parts. Small droplets of colloid were present between the cells and about the capillaries. The pathological diagnosis was hyperplasia or adenoma of the parathyroid gland.

Weichselbaum in 1907 reported finding a tumor of the upper part of the left thyroid gland in a woman who died from pneumonia. It was 4.3 by 3 by 5 centimeters soft movable and red gray and without evidence of malignant change. Histologically several types of cells were present including normal parathyroid and oxyphile cells, aggregations of radially arranged cells about central lumina and undifferentiated masses. The tumor contained no fat and the diagnosis between adenoma and hyperplasia could not definitely be made. In the discussion following the presentation of this case Askanazy stated that he had seen a similar parathyroid tumor in a patient with osteitis deformans and he raised the question of the possible connection between the two diseases.

Verbitz noted at autopsy a diffuse hyperplasia of one of the parathyroids measuring 2.5 by 1.75 by 1.5 centimeters which showed a new growth of epithelial tissue and oxyphile cells regarded by him as adenomatous. Erdheim and Bauer found

an adenoma of one of the parathyroids in a woman of 45 who died of nephritis and who had a moderate degree of osteomalacia.

Harbitz reported three cases. In a woman of 26 who died of osteomalacia and tuberculosis he found an oval tumor 3.5 by 3.5 by 2 centimeters adjacent to and below one lobe of the thyroid and corresponding exactly with the location of one of the parathyroids. Harbitz believed that this was an adenoma but admitted that the cells did not closely resemble the glycogen containing (chief cells) of the normal parathyroid which cells are similar to those of the adrenal cortex and hypernephroma. His second patient died from arteriosclerosis and chronic alcoholism and there was a history of paralysis agitans. The autopsy revealed two tumor like bodies the largest of which measured 2.5 by 2 centimeters which corresponded with the inferior parathyroids in location. Microscopically there was no real glandular structure and the cells were in compact anastomosing rows. He concluded that these tumors were too large for a hyperplasia and interpreted them as adenomata. Harbitz's third case was a woman of 32 who died of pulmonary tuberculosis 4 weeks after childbirth. At the lower left pole of the thyroid was a yellow white encapsulated mass 1.1 by 5 centimeters. This tumor was made up of densely packed epithelial cells divided into lobes by connective tissue septa. In the capsule were elongated nests of parathyroid cells which supported the author's belief that this was a true adenoma. In all three cases the tumor cells took a definite eosin stain but in none of them were oxyphile cells seen.

Erdheim reported a tumor removed at the autopsy of a patient 18 years old. He did not state the sex. The specimen measured 2.5 by 1.5 centimeters and was at the lower pole of the thyroid but not definitely connected with it. The structure consisted of irregular masses of cells among which were colloid droplets but definite follicle formation was lacking. No other parathyroids were found so the conclusion favored was that this represented a work hypertrophy rather than a true tumor.

Strauch's case was similar to Erdheim's in that no other parathyroids were found and the author concluded that the growth resulted from excessive functional demands. His tumor was removed from the neck of a woman who died after a typical attack of puerperal osteomalacia. It measured 4.5 by 3.2 by 3.5 centimeters and was made up of pale rose colored cells eosinophile cells and other normal elements of the parathyroid and Strauch believed that the presence of all of the normal

clement suggested the compensatory hyperplasia conclusion and disprove the idea that this was a true adenoma for he found that only one type of cell is found in the latter. He also believed the tumor growth to be the result rather than the cause of the osteomalacia.

The manner of embryological development of the parathyroids is quite generally agreed upon by several authors but there has been some difference of opinion as to the normal histological structure. Thompson and Harris studied the gland in 50 routine autopsies and arrived at a definite conclusion. They determined the fat content to be constant in adults and mentioned that the distinct yellow color therein was of value in the gross differentiation of the glands from the other small neck organs. Erliheim Kaufmann and Gierke have found intracellular fat in the normal parathyroid irrespective of the nutrition of the individual and have mentioned that this increases in amount with age.

Thompson and Harris found cell 11 when present at all to be widely distributed. They identified cell 11 in 14 per cent of their cases and considered it a normal in individual over the age of 50. They remarked that when found it may make the parathyroid look a great deal like thyroid tissue in some areas but that this should not be confusing. They did credit a relationship between these two organs on embryological physiological or anatomical ground.

Thompson's classification of the parathyroids are discussed in general by several authors. Livingston in his textbook mentions both adenoma and malignant tumors of the parathyroid gland and malignant growths are infrequent in the thyroid. He lists several distinct cell types which may be present in these tumors, i.e. (1) columnar of aqueous epithelium (2) nuchal in palisade form and also forming alveoli (3) large clear cell with dense cell borders and cytoplasm rich in glycogen and (4) groups of strongly lipophilic cells. He speaks of the frequency of large blood space and of canal lined by columnar epithelium and the difficulty of differentiating from thyroid tissue when colloid is present. Both he and Harbitz realize the difficulty in deciding between a moderate diffuse hyperplasia of the parathyroid and a true adenoma of that organ.

Gierke believes the adenomata consist predominantly of glycogenic containing elements resembling the chief cell whether they arise from the glands themselves or from intrathyroid rests. He also mentions the possibility of the latter possessing malignant properties. Histologically he describes several cell types in the normal parathy-

roid. The epithelial cells are (1) chief cells which are either small with dark nuclei and pale granular eosinophilic protoplasm (2) or atretic cells or water pale cells with a foamy poorly staining protoplasm and (3) oxyphilic cell with variable eosinophilic granules. The latter type lie in groups and are particularly found in old people. The water pale cells contain most of the glycogen and show an increasing fat content with advancing age. He also noted inconstantly both between the cells and in follicles a colloid like material which he thought was due to delayed reabsorption and does not believe that there is as yet known any histological evidence of increased activity. Getzow has essentially the same classification for the cells of the normal parathyroid but he emphasizes the presence of slit shaped spaces lined either by endothelium (lymphatic) or epithelium (the chief cells) or due to the decapsulation of the glandular parenchyma.

CONCLUSIONS

1. Adenomata of the parathyroid are comparatively rare tumors.

No unquestionable case has been reported in which a tumor developed from a parathyroid rest in the thyroid gland.

3. Apparently benign tumors of years duration may suddenly take on malignant characteristics.

4. The question of true adenoma formation or of hyperplasia may be difficult to decide in cases of enlargement of the parathyroid gland.

5. Parathyroid tumors can be differentiated from those of thyroid origin but the two may be easily confused.

6. The connection between neoplasms of the parathyroids and diseases of the bones is not definitely known.

7. Compensatory hyperplasia of the remaining parathyroid after removal of one or more of the glands probably may occur rapidly and without apparent symptom.

8. Histologically tumors of the parathyroid may vary considerably in the predominance of cell types.

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EDITORIALS

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APRIL 1929

PRODUCTIVE HOSPITAL WORK

OUR surgical and medical activities now center about hospitals. In most of our communities the efficiency and progressiveness of the hospital work give a fair indication of the type of surgeons and physicians located there. Real efficiency in hospital work calls for high grades of devotion and ability in the members of the two governing bodies, the managers and the medical board. The holding of a position on either of these boards should entail serious responsibilities.

The managers frequently have very great difficulty in providing the funds for carrying on the work of the institution properly. Their duties cannot be performed efficiently unless they have some source of income unless they have a fair degree of wisdom in determining the policy of the institution and unless they can work in close sympathy with the members of the medical board for the success of the hospital.

The medical board must provide for the professional work of the hospital. If each doctor can gain eminence in a useful department of his work, the success of the hospital

is practically assured. There are multiple examples of the benefits which have come to hospitals through the success of the member of the attending staff. These outstanding men often handicapped at first by inferior facilities have had the vision, the industry, and the ability which has brought real achievement and the institutions in which they have worked have reaped a large share of the benefit. Hence when we talk of productive hospital work, we naturally think of notable achievements by the members of the staff of the hospital and we wish to establish the kind of organization which best encourages such accomplishment.

There has been an evolution in professional work which has corresponded somewhat to the developments in the industrial world. The entire output of individual forges, small isolated blast furnaces and factories scattered throughout the land was far less than the present output of the United States Steel Corporation. Automobile production, transportation and other industries abound in similar examples of efficiency which show that well organized effort is far more productive than unorganized effort.

Organization of the work in hospital has progressed along similar lines. The hospital where many men are snatching bits of time from private practice and where they are each devoting these snatched moments to about the same kind of work cannot be expected to have a high grade output.

Our most productive hospitals are those which are organized on the basis of a wise directorship conjoined with groups of efficient workers who have opportunities for develop-

ing special kinds of work and gaining eminence in them. This means co operation—but co operation is the essence of modern development. If the doctors have appreciated this and have contributed fair amounts of properly directed effort they have prospered marvelously; if they have failed to do so they usually have dragged along in mediocrity.

Successful organization of this type has certain fundamental requirements:

1. The directorship may be in the hands of one man or of a group of men, but it must be broad minded and generous; it must avoid unwise activities which are based on ignorance or prejudice, and it must aim to provide the best available opportunities for each group of workers.

2. The groups of workers must make efficient use of the opportunities for training which the hospital gives; there must be a 'trying out' process for surgeons, physicians, and executive and nursing staffs which corresponds to Nature's rather cruel method of the 'survival of the fittest.' Any staff member who expects the hospital to carry him should soon be put in the discard.

Those who consider hospital work less important than private practice, which is not related to that work, or social or sporting activities, or business speculation, and those who are fundamentally untrustworthy or lazy should not expect to be successful.

3. There must be a vital *esprit de corps*, a certain idealism, a sense of loyalty to the institution and to each other. Each patient must be given a "square deal," fair consideration and careful, skillful attention.

4. The members of the staff should have educations so broad and judgment so correct that the concentration of individual effort will not lead to unwise procedure. Each physician and surgeon should have a judicial grasp of the broad fields of medicine and surgery.

5. The hospital authorities and the profession at large justly expect contributions to the advancement of scientific knowledge. Those who have exceptional opportunities for observation have corresponding obligations to give some of the benefits of these observations to others. It is unthinkable that there should not be something worthy of record where a large mass of clinical observations is properly made.

6. The work should be done primarily on a humanitarian basis. It is the pride of the profession that this is true. But in comparing our activities with those in other callings we must note the growing broad minded human interest which is evident in the industrial world. We may remember Mr. Charles Schwab's recent statement to the effect that the future of industry will depend less upon developing new machines than upon developing the management of men on a human basis.

I have an abiding faith in the general superiority of the members of our profession and do not wish to find some time that there is a greater proportion of broad minded co operation in the business world than in ours.

CHARLES N. DOWD

CURETTAGE PRECEDING HYSTERECTOMY

DURING recent years attention has been directed by several well known surgeons to the frequent development of carcinoma in the cervical stump after supravaginal hysterectomy. Polak in 1900 collected 256 cases in America in which cancer occurred in the cervical stump after subtotal hysterectomy for fibroid tumors. Cases in which cancer developed within one year of hysterectomy were not included in his list on the supposition that in such cases the disease was co-existent at the time of operation.

Cases in which there is strong clinical evidence that cancer existed at the time of supra vaginal hysterectomy and was overlooked are perhaps equally numerous if not more so

Ample statistics gathered from various sources seem to show an incidence of cancer associated with fibroid tumors of the uterus of above 2 per cent

A few years ago in reviewing the records of the Massachusetts General Hospital for five years I was able to find eight cases of cancer of the cervical stump following supra vaginal hysterectomy for fibroid tumors. The original operation had been performed elsewhere in one half of these cases. In four cases signs and symptoms of the disease followed so soon after the operation as to make the presumption uncapable that cancer existed at the time of the original operation. It is interesting to note that in three of the eight cases the patients were single women in whom therefore the trauma of childbirth played no part in the etiology.

The recognition of this cancer problem in connection with supravaginal hysterectomy has led to the advocacy of various expedients for its solution. A few well known surgeons have advocated total hysterectomy as a routine procedure in operating for fibroids except in nulliparous patients when the cervix is free from injury or disease. However it is felt by most surgeons that such a radical stand on the part of the average operator would be likely to lead to an operative mortality higher than the incidence of the disease itself. Other leading surgeons advocate as a less radical procedure the coming out of the cervical canal with the knife or the cautery. While undoubtedly somewhat quicker and perhaps attended with fewer sequelae than total hysterectomy this technique cannot to my mind be considered desirable if cancer already exists in the uterine

canal nor can it be considered a preventive of cancer subsequently developing in the portio vaginalis as sometimes happens.

No routine measure can adequately meet the situation each case must be considered individually. The frequent association of cancer of the body of the uterus or of the cervix with uterine fibroids should be borne in mind whenever operation is contemplated.

The cervix should be inspected and palpated with care previous to operation and a biopsy done if malignancy is suspected. If the cervix is badly lacerated eroded and inflamed organ total hysterectomy is of course indicated. Even if the cervix appears innocent and supravaginal hysterectomy seems to be the operation of choice it is my firm conviction that a preliminary curettage should be done in every case immediately preceding the laparotomy. If the curettage is negative no harm is done and only a few moments of time has been consumed and one may proceed to supravaginal hysterectomy with a clear conscience. If there should be a co-existent carcinoma of the body of the uterus or of the cervical canal the curette will reveal its presence clinically. I believe nine times out of ten. If the curette finds a soft spot in the wall of the uterus from which much friable tissue is obtained while elsewhere the normal scraping sound and feel is elicited such a suspicious circumstance would warrant an immediate total hysterectomy even if confirmation by microscopical examination of fresh tissue is not available to the operator. Of course the availability of such expert laboratory guidance in doubtful cases is most desirable.

This use of the curette will I believe reveal carcinoma of the uterus clinically in practically every well developed case and will permit of a more intelligent decision between total or supravaginal hysterectomy than can otherwise be obtained. LINCOLN DAVIS



WILLIAM D HAGGARD
1826-1901

MASTER SURGEONS OF AMERICA

WILLIAM DAVID HAGGARD

A PIONEER surgeon of the early abdominal era, a virile inspiring and long remembered teacher of surgery, one of the founders and the first president of the Southern Surgical Association, an able and unusually active practitioner for fifty years in Tennessee. William David Haggard of Nashville died January 25, 1901. He was the eldest of the ten children of Ezekiel L. and Malinda Haggard and was born at New Market, Marion County, Kentucky, October 17, 1806. His forebears emigrated from Albemarle County, Virginia, with a company of some two hundred in the latter part of the Eighteenth century. They crossed the Alleghenies and took up land near Lexington. In this community they founded at Winchester the first Baptist Church west of the mountains. The records of Salem Church for 1799 contain the minutes of a meeting in which the grandfather of Dr. Haggard, with this same given name, was the moderator in trying one of the members before courts were established.

Dr. Haggard was educated at the Academy at Lebanon, Kentucky. Early in life he evinced the rare energy of his parent and cherished the ambition to become a physician. When he was eleven years of age his father died of malarial fever. The slaves on his river bottom plantation were given quinine, which was just being used tentatively. They recovered. The master was given the old preparation of cinchona bark but died after a fortnight's illness at the early age of 38. The son devoted himself to the affairs of the farm and assisted his mother in freeing their property from encumbrance. He then taught school and afterward became tax assessor of Marion County at the age of nineteen. He continued these occupations until he had earned enough money to give himself a medical education.

He entered the office of Dr. Shuck at Lebanon to read medicine in 1847. After a year's preliminary reading he took his first course of lectures at the University of Louisville. The next year he followed his professor of surgery, Samuel D. Gross, to Philadelphia when Dr. Gross was called to Jefferson Medical College from the University of Louisville. The fine Kentucky horse which was ridden to Philadelphia when sold paid his tuition and keep for this college year. Others of the faculty at that time were Meigs, Mütter, Dunglison, and Metcalf. He graduated with distinction in medicine in March, 1851. The subject of his

graduation thesis was Enteromesenteric Fever There were 8 men in the graduating class

Dr Haggard located in Gallatin Tennessee in May 1851 and soon established a large practice In 1859 he married Martha the oldest daughter of Dr and Mrs Elmore Douglass who bore him two daughters and died in 1866 Her mother had been previously married to Governor Sam Houston

At the outbreak of the Civil War the border state of Kentucky was torn with discord Families were divided in their allegiance Brothers took opposite sides in the great conflict Dr Haggard stood for the preservation of the Union and remained at his post of duty as one of the two physicians for the entire population of Sumner County Tennessee His brother Volney entered the Confederate service and was killed at Manassas

Dr Haggard moved to Nashville Tennessee in 1875 In the first year of his residence in that city he became an instructor in obstetrics in the Medical Department of the University of Nashville and Vanderbilt University

In 1884 Dr Haggard was chosen to fill the chair of diseases of women and children in the medical department of the University of Tennessee which he occupied with great enthusiasm and success until 1900 At the meeting of the American Medical Association at New Orleans in 1885 he was elected chairman of the section on obstetrics and diseases of children He was for many years one of the attending surgeons at the Nashville General Hospital and was also made gynecologist to St Margaret's Hospital He was the first president of the Southern Surgical and Gynecological Association in 1888 in 1892 he was elected president of the Nashville Academy of Medicine and in 1893 he was one of the honorary presidents of the Pan American Medical Congress He was a teacher of gynecology and abdominal surgery for nearly a quarter of a century and thousands of his former students throughout the South and West bless and honor his memory

In 1870 he married Jane Douglass a daughter of Mr and Mrs Robert Bruce Douglass They had two children William David Jr born in 1872 and Douglass born in 1876 both of whom are physicians The elder son was associate to the chair of abdominal surgery and gynecology in the University of Tennessee before its amalgamation with Vanderbilt University in 1911 when he was made professor of clinical surgery

Among the first of the old school surgeons to embrace the Listenan principle Dr Haggard practiced it scrupulously and at the same time imbued his associates and students with its tenets It seems incredible that it required champions such as he In debate he was forceful and convincing As an operator his boldness was tempered with discretion his gentleness was harnessed with rapidity and his large experience mellowed overzealousness into that most coveted of all surgical attributes good judgment

Dr Haggard was prompt and scrupulous in all things. He did his day's work faithfully with no regard for the morrow. His day began early and punctuality was his creed. He once told me this practice had saved him much time and enabled him to accomplish his self-imposed tasks. He applied the Golden Rule in all the relations of life. I asked him how this rule could be applied to an enemy and he said, 'If one places himself in his enemy's place and gives his enemy credit for honesty, he can at least be reconciled to the position his enemy takes. He treated his friends with the greatest consideration. He accepted the sorrows and the difficult trials of life with courage and fortitude. The mellow radiance of his loving personality permeated every private, social and professional effort of his successful and useful life.

Many surgeons throughout the South received their early training under this illustrious teacher who inspired them with real manhood, the joys of personal service and the splendor of surgical achievement. In one class he trained three surgeons who added luster to the South and its long line of eminent men: Dr Richard Douglas of Tennessee, Dr W. E. B. Davis of Alabama, and Dr John Wesley Long of North Carolina. Dr Long made the speech in presenting the teacher with the customary gold-headed cane of that period. Each of these men succeeded their teacher and mentor as president of the Southern Surgical Association and received many other honors in this country and abroad. They were among the first group of early and enthusiastic men in the South in the development of abdominal surgery in the eighties. Dr Haggard fired his classes with admiration of the heroic and humane phases of a doctor's grave responsibilities and unusual opportunities for superb if sacrificing service. The ethics, traditions and ideals of the forefathers in medicine were very real and very sacred to him. His wealth of knowledge of the historic episodes of medicine were as a tonic to the ambitions of his hearers. He made a moving pageant of the unheralded ride of Ephriam McDowell along the self-same road that bounded the college campus on his way to the Hermitage, twelve miles away, where in 1822 he performed his ninth ovariectomy, a score of years before the profession knew that such a thing was possible. He had ridden horseback from his home in Danville, Kentucky, and no less a personage than General Andrew Jackson assisted him at the operation. This intrepid spirit, brave and tender in peace as he was fearless and unconquerable in war, held the hand of his neighbor and otherwise supported her fortitude. The patient was a Mrs. Overton who thanked God and honored Dr. McDowell for her recovery. When the surgeon presented the check which her husband had given him at the little bank on the public square, the cashier counted out \$1500.00. He returned the money, saying he had told Mr. Overton that his bill was only \$500.00. A runner was dispatched to the Hermitage, who returned with the message from the husband saying that he had understood the amount of the doctor's charge, but

had tendered him this additional honorarium with his thanks and with the earnest request that he accept it

It was through Dr Haggard's co operation with Dr W L B Davis that the Southern Surgical and Gynecological Association was organized Dr W L B Davis and the writer in 1887 organized the Alabama Surgical and Gynecological Association Dr Haggard had the vision of an association embracing the entire South which had no outlet for its work and no special societies At the first annual meeting of the Alabama Surgical and Gynecological Association it was converted into the Southern Surgical and Gynecological Association Dr Haggard was the first president in 1888 and was succeeded by Dr Hunter McGuire of Richmond Dr W L B Davis was the first secretary The name was later changed to the Southern Surgical Association Perhaps more than any of his confederates in the launching of this society destined to play such an important role in the development of advanced surgery in the South Dr Haggard had a vision of its rare usefulness He prophesied a unique position for this brain child of his imagination It has united the flower of southern surgeons with the nationally known colleagues from the great centers The meetings of this distinguished group have created a literature in its two score volumes of *Transactions* with which few other surgical societies are comparable

As a writer on gynecology and the earlier abdominal surgery he showed a prophetic grasp of the developing new era His contributions were prepared with meticulous care and betokened unusual accuracy of observation and deduction He was by nature gifted with those qualities as a speaker which win men over and his happy sense of humor made him a genial companion A keen and critical wit was redeemed by a kindly nature that treed satire from the sting that is too often its spark and its dart He was an interminable tireless worker and his dry book for many years recorded in a careful hand visits to the number of fifty or more a day over long period In his very plan of giving himself he became known as the well beloved Good will flowed into his life He planned carefully acted logically and refused to be moved by precedent alone He was possessed of great magnetism and a gracious personality He was essentially an optimist *Always captian of his surroundings he was steadfast and immovable in a just judgment*

The enthusiasms of accomplishment and the appeal of friendship were essentially linked with his emotions Every hour was jeweled with purposeful effort He wore the red badge of courage Well poised sane generous to a fault he was the soul of honor His life was a religion of service His surgical resourcefulness was inspired by a wealth of experience and his wellnigh unerring judgment was allied with supreme caution

J D S DAVIS

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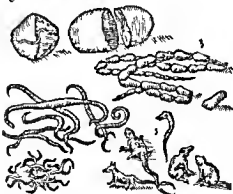
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THE SURGEON'S LIBRARY

OLD MASTRPIICIS IN SURGERY

ALFRED BROWN M.D. JACOB OWAMA NIMRAKA

THE NATURE OF DIVINE CHARACTER BY CORNELIUS GEMMA

THE learning and knowledge of any given subject when studied as a historical problem is gained from a cross section obtained by a review of the works of the prominent men of the period under consideration. This being taken as a criterion in evaluation of the medical and surgical knowledge of the sixteenth century is particularly difficult to determine accurately, as in making such an evaluation both sides of the scale must be considered. On the one hand are the practical workers of the period, usually sane solid individuals in great part beginning *de novo* taking things as they find them and doing the best they can with them. From this group in surgery at least have come the greater part of things worth while not only in the sixteenth century but throughout the entire existence of the science. To this group belong such men as De Vigo, Brunschwig, Iarr, Franco and many other. During their lives they were greatly in the minority and a larger more influential group dominated the surgical world. To this belonged the teachers in the schools. These men steeped in the tradition of ancient medicine and inheriting some if not all of the mysticism and belief in the supernatural of demonology and its attendant nonsense held high positions and their word spread through the rank and file of the medical profession and was considered by many the law and the gospel. Naturally they represented a sliding scale not quite from the sublime but some of them surely to the ridiculous.

To us the books of the men of the first group stand out as the important works of the period but in order to get an insight of what was going on in surgery we should turn to the other end of the scale and see what we find there. The work of Cornelius Gemma appears to be about that end of the scale for it shows us a work written by a man well thought of, evidently well read and in some ways a good practitioner who not satisfied with his attainment in medicine and surgery branched out into almost all other fields and took upon himself the task of explaining almost everything under the sun. While doing this he invokes the aid of all the stories and old wives tales of wonderful happenings in the realm of human pathology. In the obstetrical portion of the book he shows all the monsters previously shown by Jacob Rueff and apparently believes in

them. In the portion devoted to foreign material in the book he cites the case of a fourteen year old girl who after a considerable sickness passed a living eel by rectum. He shows a picture of the eel but does not vouch for the truth of the story although he apparently believes in a case in which a woman discharged pieces of wood and fully formed leaves of a tree from an abscess at varying periods over a space of nine years.

He includes among foreign bodies calcification of the valve of the heart illustrates them in the case of the emilunar valve and describes the pathology as stony sedimentation. He describes stones in the lung, gall bladder, brain, urinary bladder and kidney. When he comes to the digestive tract he describes worms in the pylorus and caecum, worms of various type, the broad worm, round worm and apparently pinworms but goes on to the polymorphous types such as frogs and salamanders. These he speaks of as certainly miraculous and infrequent.

He also relates the stone which he places in the caecum with clinical symptoms when he says: "More wonderful (a case) where a somewhat aged but large woman passed a stone almost round but a little oval the outside of which was partly brown and partly black, as if it had been burnt, which when an attempt was made to perforate it fell into two parts and showed within a substance like glass or transparent crystal with many striae and radii leading to a common center. I did not doubt that this stone was carried in the caecum for many months because of the pain which she had felt in that place and the dragging tension and weight in the right ilium under the false ribs where the caecal intestine is bound with fibrous membrane both to the peritoneum and liver and the mesentery."

Cornelius Gemma was born in 1535 the son of a physician. He rose in his profession until he became regius professor of medicine at Louvain. He was an authority on The First and obtained a great reputation in the epidemic of 1574 and later in 1579 himself fell a victim of the disease and died in that year. His principal book commonly known as *Cosmotheuticus* was printed in 1575 at the Plantin Press in Antwerp. It is a hodgepodge of distinct erudition with an admixture of nonsense which though the author did not wholly believe it nevertheless was hardly worth printing except that it is fascinating in its showing of the superstitious existing in the mind of at least one of the principal medical men of the period.

REVIEWS OF NEW BOOKS

THE seventh edition of Phillips *Diseases of the Ear, Nose and Throat* has new chapters dealing with infantile mastoiditis and paranasal sinus infection wherein gastro-intestinal symptoms predominate. There is also a revised chapter on the hearing test.

The chapters on bronchoscopy and œsophagoscopy are much improved over the other editions. There is full illustration of all new instruments and the technique as used in the Jackson Clinic. It portrayed the fact that this book has gone through even editions recommends it both as a text and reference.

J. GORDON WILSON

RECONSTRUCTIVE Surgery. Nelson is the title which appears on the cover of an extraordinary worth while book on major operations of the face.

The author has had the advantage of excellent back training and the somewhat rare combination of imagination and habit of attention to essential details. He has also had the opportunity to observe and develop himself along these lines both in his work in the large general clinic with which he is associated. All of these influences are reflected in this work. Without attempting categorically to give credit for all inherited knowledge or methods be it meek or audacious in his acknowledgments, he has salted the whole with his individuality both by the evident personal touch and by putting the operative demonstrations in the form of readily available stereoscopic cards.

There are 189 illustrations and 88 stereoscopic plates, most of the former and all of the latter being original. In the 66 pages of text he describes related surgical principles and such basic technique as preparation types of incision, manner of suturing, closing of wounds, dressings, etc., but most of it is devoted to the presentation of the definite plans he himself uses of solving the problems concerned and it is this latter practice that gives the real usable value to any book on technique.

The making of flaps, transplantation of tissues, cheiloplasty, meloplasty, treatment of salivary fistula, treatment of facial palsy, cosmetic meloplasty, blepharoplasty, preparation of the socket for an artificial eye, retraction of the lids, otoplasty, cosmetic and reconstructive rhinoplasty, correction of abnormalties of the septum, of asymmetry of the nose, of saddle nose, non-specific rhinophyma, retraction of nasal bones and lip of leucic saddle

nose surgery of the columella and their correlated factors are attacked directly and presented concisely. His training as a rhinologist has made him particularly interested in and adept in reconstructions of the nose and eyelids and these chapters are pre-eminent in this well conceived carefully executed work.

V. P. B.

IN the preface of a new book on pharmacology and therapeutics, Dr. McGuigan states: "The aim of this book is to present clearly the important facts of pharmacology and to give the basis for these facts." In this he has succeeded admirably and students in particular will appreciate the clear and concise way in which he presents the material. Conflicting literature is not reported in detail to leave the student in a maze. While the clinical application of the pharmacological matter is in every case indicated, the therapeutics is of necessity brief. In addition to the discussion of drugs and other therapeutic agents, Dr. McGuigan included also a section on the pharmacopoeia and on prescription writing. This is very well done. His emphasis of the metric system is to be commended. Perhaps it would also be commendable if he advocated English instead of Latin.

C. A. D.

THE fourth edition of French's well known book *The Indication of Differential Diagnosis of Main Symptoms* appears eleven years after the third. It is an even larger work than before, consisting of nine hundred and forty-three pages of heavy glazed paper and an analytical index in two hundred and twenty-five pages. Many full colored figures have been added. They are very realistic and most instructive. For instance, the pictures of the cyanosis occurring during influenzal pneumonia are most striking. The value of this work, of course, unquestioned. It is chiefly a clinical counselor, wisely suggesting the thoughtful consideration of all possible causes of the presenting symptoms. The edition is well up to date with the newer kidney function tests included and a brief summary of the most recent developments in X-ray diagnostic technique. It contains an encyclopedic variety of clinical information.

P. S.

JERMAN'S *Modern X-Ray Technique* is an exposition of the details of the technique and procedure in producing the best possible X-ray films. The author bases his material on an unusual

By T. H. C. H. N. P. M. D. J. D. N. S. A. L.
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experience in X ray technique acquired during the course of many years of actual work with X ray apparatus. The subject matter is presented in a direct positive way which cannot be otherwise than helpful to the student and beginner in the X ray field. When one has had the extended experience in technical X ray work not only in the actual practice but also in the instructional side of the work as has this author he can speak with authority on the subject that is covered by this book.

This work is written in an entirely impersonal manner. It is characterized by a brief mention or a complete absence of the usual descriptions of the older and antiquated pieces of X ray apparatus that so many writers feel must be included in work on X ray. Thus very little space is wasted on apparatus long since out of use or discarded such as the static machine, the induction coil and the gas X ray tube (which at least 75 per cent of the X ray technicians of today have never used and many have never seen).

The author stresses the value of standardization of X ray exposure formulae and the calibration of X ray apparatus in order to enable the technician to obtain with confidence a constant duplication of results. Thus this method displaces the hit or miss rule of thumb method which has been in vogue these many years in various X ray laboratories with the uncertainty of results, frequent failures necessitating rereaying loss of time etc. Illustrations of the posturing of patients for the more common exposures are given which provides the technician with a clear visualization of this part of the technique. With this book as a guide the X ray technician who is acquainted with the fundamentals of X ray physics should be able to obtain superior X ray films for the doctor who depends on his or her services in the technical phases in medical roentgenology.

In a section on Interpretation which the author treats in an abstract manner he stresses the importance of this being the forte of the professional radiologist but does not specifically state that this refers to the medical radiologist (physician) a specialist trained and experienced in X ray interpretation. In no part of the book is there any reference to the diagnosis of X ray shadows nor is there any reference to any of the medical problems connected with X ray work.

Many of the chapters are concluded with an extended question and answer resume of the subject treated.

This book will be welcomed by the X ray technician who desires to improve his work and by those who have been students in X ray technique under the author.

EDW. S. BLAINE, M.D.

In his recently rewritten text of *Urology*¹ Edward L. Keyes of New York has again made the reading matter both unique and interesting. unique be

cause of the aphorisms and individual experiences of the author interesting and easily read because the burdensome details of description are omitted. This latter fact is particularly true of embryology and anatomy. It is presupposed that the reader has already gained such knowledge elsewhere so the book is primarily for one who wishes to gain quickly a view of clinical urology and also the important principles of therapy. From this aspect the subject matter is probably ideal for the beginning course of urology in medical schools.

Clinical urinalysis or the ability to look at urine and interpret what we see therein is stressed. Not everybody will agree with the author that the audible curve or Benique sound should be used for the urethra.

In a thorough discussion of instruments, their use and care of cystoscopy and pyelography, the use of pyeloscopy (Leguen) is evaluated although a relatively new procedure it helps to distinguish fixed deformations of the kidney from temporary defects as no other method does. The gravity method is recommended for all pyelograms.

Blood chemistry of urological patients is important in so far as the non protein nitrogen and creatinine are retained. The inclusion of a chapter on urologic pharmacopoeia is timely.

Infection of the urinary tract has very aptly been given several chapters. Infection of the right kidney in small girl is explained by the excess mobility and susceptibility of this kidney. In chronic renal infections the author believes that the vaccines whether autogenous or stock are of no value. He also believes that mercurochrome has no real intravenous antiseptic value.

Throughout the text acriflavine solution 1:1000 is recommended and favored as a general urinary antiseptic prophylactically or therapeutically.

The author disposes of ureteral stricture by saying that a stricture or spasm of the ureter must produce symptoms as proven by the fact that dilatations of the ureter relieve the symptoms or there has been no stricture or spasm. He emphasizes that cystitis is only a symptom and its cause must be sought.

One must note that in chronic infection of the seminal vesicles vasectomy is preferred to any kind of injection into the vas deferens. In the pages devoted to prostatism and retention the reviewer could not help but notice that the author stressed the point that the only cystoscopic evidence of bladder paralysis is the open internal sphincter.

For bladder operations spinal or general anesthesia is preferred. Prevesical section as a substitute for the two stage prostatectomy and as a preliminary to suprapubic lithotomy to obviate the danger of pelvic cellulitis and the shock of cystotomy is strongly recommended.

Tumors of the urinary tract are described in a most sensible manner. Several times the author brings out the point that retractors sometimes obscure bladder tumors so should be moved into different positions during operation.

¹ Urology By E. L. Keyes, M.D. Ph.D. F.A.C.S. New York
! Lo 1 D. W. P. L. C. d. C. m. p. 93

The subject matter and conclusion is valuable in that father and son have earned on a study of urology from the leg g n America to the present time II C T E

BECKING with a chapter on development Braun's book on *Sinus Thrombosis* is a lucid and complete embryology of all the cerebral sinues from here on the subject is taken up in chronological order the four chapters being devoted to anatomy etiology and pathology symptoms a lig o a finally treatment

The chapter on anatomy is able to show the connection of the relations and abnormalities of the cerebral sinues and to correlate them with the clinical picture Dr Brau has done his utmost in that regard but has left nothing done in regard to the subject

For the light that is shed by the protean manifestations of a sinus thrombosis and the difficulty in arriving at a correct diagnosis. Of all signs and symptoms the most important element of the cerebral sinus is that it is too often ignored in not obtaining the correct diagnosis of the interference Dr

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D O N E I N R E G A R D T O T H E
S U B J E C T

Braun has kept this in mind and discusses every possible means of arriving at a differential and correct diagnosis. The Tobey-Ayer test based on the Queckenstedt phenomenon is described in determining which jugular is involved. The differential diagnosis of typhoid fever, erysipelas, acute miliaria, tuberculosis, and septic endocarditis is discussed.

Cognizant of the futility of schematizing the treatment of otogenic sepsis, the author has laid down no hard and fast rules to follow. There are too many variable factors which must be taken into consideration. Each case must be considered individually and the operator guided by his own judgment.

Operative interference on the cavernous sinus is still fraught with danger and great difficulty. The author reports the cure of only two cases following operation. While Dwight and Geinain found that 7 per cent recovered spontaneously. The three methods of approach to the cavernous sinus are described and illustrated.

Dr Braun has given to otology a clinical picture of sepsis of otitic origin and has made it possible to correlate the clinical picture with the underlying pathological condition. He has put into the hands of the specialist a ready reference to be consulted when suitable cases arise. J H F DE R

BOOKS RECEIVED

B K D K I G D T H D P T M T
I I K I K M T M U T I D E D A F I T
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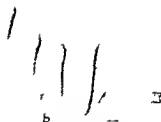
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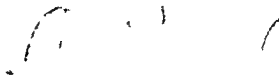
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THE TREATMENT OF RAYNAUD'S DISEASE BY RESECTION OF THE UPPER THORACIC AND LUMBAR SYMPATHETIC GANGLIA AND TRUNKS¹

WILFRED WADSON, M.D., F.A.C.S., ROCHESTER, MINNESOTA
S t a n l e s s e y T h M y C l

AND
GEORGE J. BROWN, M.D., ROCHESTER, MINNESOTA
D e s t i n e e T h M y C l

THE physiologic results obtained by the various operative procedures on the sympathetic nervous system have stimulated various physicians and surgeons to seek clinical application of the phenomena. Consequently medical literature at present is filled with varying reports. This state of affairs will continue until knowledge of the anatomy and the physiology of the sympathetic nervous system has become established. While some of the data is contradictory and opinions differ, there will gradually crystallize general conceptions which will direct the clinical application of the various operative procedures. The present discussion will be devoted to general considerations and therapeutic effects obtained following resection of ganglia in the treatment of Raynaud's disease.

HISTORICAL DATA

The historical development of our knowledge of the diseases affecting the peripheral arteries is marked by four outstanding achievements. The first definite reference to the relationship of gangrene to disease of the arteries to our knowledge was that of Quesnay in 1739, but the idea of an obstacle to the course of the blood was clearly stated by

Hubard in 1817. The exact nature of this process, however, was made clear in the work on embolism and thrombosis done by Virchow, who called attention to the fact that the degeneration *per se* of the arterial wall was not sufficient to cause gangrene. His work clearly defined the mechanism for the genesis of gangrene due to embolism and thrombosis and gave a new direction to research. The second contribution was that of Raynaud in his thesis in 1866 and in his 'New Researches' in 1874. His studies brought out conclusively that there is a form of gangrene without demonstrable organic disease or occlusion of the arteries. Probably the first known case of this type of vascular disease was observed in 1609 and was described by Bernard Schroeder. A symmetric recurring form of gangrene of the extremities in a young girl. Following the studies of Raynaud, advances in our clinical knowledge of the disease have been few. Hutchinson in 1871 noted the association of proximal hemoglobinuria in some cases of local asphyxia. Since that time many cases of this type have been reported by various workers. The translation of Raynaud's contributions into English by Barlow in 1888 and Monro's monograph in 1899 while not adding

R d e f t h t y e l i t h I m t g f T h W t g e n A s o t C h a D m l 4 1 5 9 8

much new to the knowledge of the disease served to draw the attention of English speaking physicians to this interesting condition. The description by Weir Mitchell in 1878 of another form of vasomotor neurosis which affected the extremities and is of the intermittent dilatory type which he termed erythromelalgia constitutes the third important contribution.

The fourth mile post was marked by the contributions of von Winiwarter and later by those of Buerger who separated from the group of arterial disease of an occlusive nature a clinical entity occurring almost exclusively in the male, termed by Buerger thromboangiitis obliterans (10). Knowledge of this disease clarifies many of the doubtful cases which subsequently had erroneously been diagnosed as Raynaud's disease in the male sex.

CLINICAL FEATURES OF RAYNAUD'S DISEASE

A wide experience with various forms of vascular disease of the extremities allows a separation of the cases presenting vasomotor disturbances of the spastic type into four groups. First there is a fairly large group of so-called normal persons, predominantly females, who have cold hands and feet frequently have disturbances such as mild degrees of pallor in symmetric single digits, the so-called dead finger or mild cyanosis usually associated with moist clammy cold extremities. The persons are frequently of the ischemic type and suffer easily from cold. The surface temperature of the extremities is subject to wide fluctuation depending on variations in the environmental temperature. This condition does not constitute a disease as symptoms are usually absent and the physician is rarely consulted unless the changes in color are striking. These subjects are classified by Mueller (30) as having a vasomotor constitution. We have designated them as suffering from subnormal vasomotor state. Second there are gradations from these so-called normal persons to those in whom the disturbances in color in the extremities are more profound frequently paroxysmal in nature occurring with lesser degrees of

lowered temperature. Attacks of pallor may alternate with or be followed in a period of months by more or less chronic states of cyanosis. The signs and symptoms are of sufficient intensity for the patient to seek advice from the physician. The symptoms usually consist of numbness occasionally partial anesthesia during the period of local asphyxia, extreme coldness during the state of syncope and dull aching distress during the period of syncope and cyanosis. With high environmental temperature the hand becomes excessively warm and red accompanied by sensations of burning. Third is another group of persons who have a further aggravation of the disturbance. The attacks of pallor become more intense more painful or a condition of chronic cyanosis or asphyxia supervenes. Temporary recovery is much more difficult. The changes in color are induced by the least change in temperature. The hands and feet frequently become swollen and puffiness trophic disturbance then appear consisting of minute areas of gangrene in the tips of the digits with symmetric distribution. The fourth group consists of the more severe but much rarer type of case in which gangrene may develop in the entire end of symmetric digits without prolonged antecedent history of vasomotor disturbance. Pain may be a marked feature.

All of these groups fulfill the criteria laid down by Raynaud, namely symmetry of the disturbances, intermittency or paroxysmal nature of the disturbance in accordance with its functional basis and the existence of pulsations in the arteries of the affected part. We are of the opinion that the foregoing groups represent different degrees of the same underlying fault of the vasomotor mechanism justifying the nomenclature of vasomotor neurosis of the spastic type and that the term Raynaud's disease should be reserved for the type of case included in the second, third and fourth groups. The case in the first two groups probably represent an exaggeration of the vasomotor changes which occur in the normal subject on exposure to cold. There is in the peripheral areas a transitory phase of pallor or cyanosis with exposure to increased local or environmental temperature.

redness and increased surface temperature resists

ETIOLOGY

The etiology is unknown in the idiopathic or primary types of Raynaud's disease. The influence of heredity has not been striking in the cases reviewed in the literature by Monro; it approximates 8 per cent. While this is in line with our impression relative to the well marked cases of Raynaud's disease, the subnormal vasomotor types seem definitely of a constitutional nature and many members of the same family exhibit this tendency.

The contributing factors are perhaps of more importance. The incidence of sex we believe is of great importance. In Raynaud's group of 5 cases 80 per cent were females. If the cases of doubtful diagnosis in his group are eliminated, this percentage increases to 88. In the cases reviewed by Monro 62.6 per cent were females and 37.4 per cent males. Although we have not made an analysis of the cases observed in The Mayo Clinic in our experience the idiopathic or spontaneous type of Raynaud's disease in the male sex is not common. If we eliminate the cases of vasomotor disturbances secondary to cervical rib, peripheral neuritis, thromboangitis obliterans and arteriosclerotic diseases, the percentage remaining which occurred in males is extremely small, less than 5 per cent, with increasing experience in diagnosis the percentage incidence in the male gradually has decreased. The average age incidence in Raynaud's disease according to Monro's data is 30.9 years for both sexes.

PROGNOSIS AND COURSE

The prognosis of Raynaud's disease is subject to wide variations. As far as is known it never itself causes death. In our experience death has been due to the consecutive or the subsequent development of an entirely different disease. The mild forms with local syncope or mild grades of cyanosis in the digits may not show change over a long period of years. We have observed many patients with a vasomotor disturbance for over 10 years who have not suffered actual pain or trophic lesions or progression of the disturbances of color. The duration of the malady is probably

of importance in making a prognosis. In mild cases in which the condition has remained unchanged for a period of 2 or 3 years the prognosis is usually good and reassurance may be the only advice necessary. For the most common type we have observed there has been gradual progression from the stage of syncope, more digits have become involved, perhaps the entire hand, and the condition has advanced into the stage of cyanosis or syncope has alternated with cyanosis. Then after variable periods of time there may be a gradual transition into a condition of chronic cyanosis of the extremities; recovery of the parts is less complete and when recovery does take place it is accompanied by excessive sensations of heat and excessive redness; sensitivity to environmental temperature becomes more acute and the proxysms are induced with slight variations in temperature, even during the summer months. Pain, numbness or dull aching during the period of syncope and cyanosis is the rule. Small dry ulcers of the skin of the digits may appear. In this primary type of case without complicating disease the prognosis is not good from the standpoint of spontaneous cure. The condition usually persists and while it does not progress to the point of serious gangrene, yet it constitutes a real disability to the patient. In the more rare forms in which gangrene supervenes early in the course of the disease, prognosis is most grave from the standpoint of preservation of the digits. This type in our experience is most rare. In considering the prognosis we believe that the important factor is the rate of progression of the disease during the first or 3 years. It has been our experience that if at the end of this period trophic changes have not appeared, usually they do not appear. We have noted also that long periods of remission may occur in cases without known cause.

DIAGNOSIS

The diagnosis of Raynaud's disease is usually simple. Recalling the criteria laid down by Raynaud, the diagnosis rests on (1) the presence of exaggerated vasomotor action as exhibited by changes in color of symmetric distribution in the extremities.

in the rarely in the elbow, none and lobes of the cuticula usually associated with discomfort itching or actual pain during the vasomotor paroxysm (2) the existence of pulsations in the ulnar and radial arteries in the hands and in the dorsalis pedis and posterior tibial vessels in the feet and (3) predilection for the female sex. The age of the patient is also significant in diagnosis. We believe that the diagnosis of Raynaud's disease should not be made solely on the existence of vasospastic disturbance. The vasomotor phenomena following or complicating some disease such as certain fevers and debilitating state should not be considered true Raynaud's disease. Likewise it is important to rule out all secondary forms of vasomotor disturbances such as those observed when cervical rib is present, thromboangitis obliterans, arterio-sclerotic disease, peripheral neuritis, certain cases of epilepsy and many other conditions. Changes in color of the extremities and these alone do not justify the diagnosis of Raynaud's disease.

ERRORS IN DIAGNOSIS

Our reminiscence in this respect has been due largely to the making of erroneous diagnoses of Raynaud's disease in the male sex. The patients when traced over a period of years have practically all given conclusive evidence of organic disease of the arteries, this has been particularly true in cases which later have proved to be instances of thromboangitis obliterans. In this disease in about 50 per cent of the cases the initial symptom is vasospastic disturbance of the involved extremity. In about 15 per cent of this group the palpable vessel revealed normal pulsation. Symmetry of the changes in color are usually lacking. If such patients are examined from year to year, closure of one or more arteries of an extremity frequently found or more rarely there may be evidence of occlusion in the digital arteries with normal pulsations in the usually palpable arteries. This mistake has been made by us a sufficient number of times to make us extremely cautious in making a diagnosis of Raynaud's disease in a male. Buerger (11) and Allen and Brown have called attention to this frequent error in

diagnosis and a review of the literature indicates that there is a superabundance of similar errors.

In like manner the vasomotor disturbances occurring in older persons do not justify the diagnosis of Raynaud's disease. The cold dead digit seen in cases of hypertension, arteriosclerosis and occasionally in glomerulonephritis is a secondary form, it lacks symmetry and the multiple phase color reaction necessary for the diagnosis of idiopathic Raynaud's disease. It is probably true that any organic disease of the vessels may be associated with vasospastic disturbances of the distal parts. The afferent impulses arise in the adventitial coat of the diseased vessels and initiate the necessary vasomotor reflex. Vasomotor color changes in scleroderma are extremely common, this has been pointed out by Raynaud, Monro and recently by Brown and O'Leary. The last two authors after studying the capillaries of the nail fold disease felt that probably there is a form of scleroderma in addition to the true or primary form. In this second form the changes in the skin are preceded for months or years by episodes of symmetric changes in color in the hand or feet usually initiated by cold. The surface capillaries are quite characteristic of those observed in true Raynaud's disease. The changes in the skin may simulate closely those which occur in the early stage of true or primary forms of scleroderma. The distribution usually is limited however to the acral regions, the skin of the chest, upper arms and face does not show the skin lesions as they are observed in the primary forms. In this type of scleroderma vasomotor reactions may occur with or following the sclerodermal process. The combination is quite common. Atrophy of the skin, pigmentation, deformities and binding of the epidermis indicate clearly that we are dealing with the true or primary form of scleroderma.

PATHOLOGICAL PHYSIOLOGY

The underlying disturbance which produces the changes in color are easily studied by microcopy of the capillaries of the nail fold and have been described by Mueller (30) Parns and Brown. In the stage of pallor

few capillaries are visible the filling of the loops with blood is incomplete and the capillaries have a segmented or broken appearance. The contained blood in the capillaries is static blood is not observed entering the capillary loops from the arterioles. The collecting venules are usually invisible or contain small amounts of blood. In the stage of cyanosis blood is admitted into the capillaries both from the arterioles and by retrograde flow from the venules. The blood enters the capillary in the form of small segments. The capillaries become dilated an increased number of them is visible and the blood in the loops is stationary or flow occurs only after long intermissions. There is gradual deoxygenation of the capillary blood with increasing cyanosis. The capillaries may become greatly distended and may lose their characteristic shape. The collecting venules become dilated. With recovery whether it is spontaneous or is induced by increasing the local or environmental temperature the arterioles open the flow of blood in the capillary loops becomes rapid and the blood changes to a bright red color. The stage of rubor then is due to a large number of open capillaries and venules many of which remain dilated to some degree and which contain red oxygenated blood.

A summary of these studies corroborates in a striking manner the clinical deductions which have been made by Raynaud on this mechanism that is in the stage of pallor or syncope there is a spasm of the arterioles capillaries and venules the degree of pallor depending on the completeness of the spasm. The stage of cyanosis is due to partial relaxation of the venules with back flow of blood in the capillary loops we have observed also concomitant opening of the arterioles the relaxation is not complete enough to allow the resumption of the usual flow. All forms of gradations in behavior are noted in different cases this amply explains the variations in color observed in certain subjects. Areas of moderate cyanosis may appear on one finger and in another deep cyanosis may remain or in one area of skin there may be recovery with return to normal pink or rubor and the surrounding skin may be cyanotic.

CALORIMETRIC AND THERMOMETRIC STUDIES

Subjects who exhibit vasospastic disturbances are especially prone to have decreased temperature of the skin with marked fluctuations in the involved parts. Under usual environmental conditions room temperature 24 to 26 degrees C the surface temperature is low in the hands and feet ranging from 16 to 25 degrees C. The surface temperature of the extremities of the average normal person varies from 4 to 33 degrees C. In cases of Raynaud's disease the fluctuations in surface temperature are extreme and constitute an exaggerated response to variations in the environmental temperature. This is shown not only with determinations of the surface temperature by the thermocouple but also in variations in the rate of heat elimination as determined by the foot and hand calorimeter. During the stage either of pallor or of cyanosis the surface temperature of the part becomes excessively low and increases with recovery to normal color. As the disease becomes more advanced there is an increasing tendency for the surface temperature to remain low. The marked vasospastic element present in these cases also is shown in the response of surface temperature and in the rate of heat elimination when systemic fever is induced. For the purpose of studying the range of the vasomotor response a procedure has been developed which gives us information on this point and serves as a useful index in determining the type of case amenable to operative measures. It is particularly valuable in cases of thromboangiitis obliterans which are frequently complicated by vasospastic disturbances. One of us (Brown) has devised what we call the vasomotor or vascular index which is determined as follows. Nonspecific protein fever is induced by the intravenous injection of triple typhoid vaccine and the surface temperatures of the digits foot and hand are taken simultaneously with the temperature in the mouth or roughly simultaneously with the temperature in the blood. In all persons including those who are normal and those with or without vascular disease after a preliminary drop due to the chill the temperature in the mouth and on the surface

rise. The magnitude of the rise in the temperature of the skin is dependent on (1) the initial temperature of the extremity (2) the intensity of the febrile reaction and (3) the patency of the arteries. In cases in which the extremities are cold and in cases in which there is considerable vasoconstriction the increase in the surface temperature is very great. The index is calculated by determining the rise in the surface temperature and subtracting from that the rise in the temperature of the mouth or blood thus in degrees Centigrade constitutes the change in temperature of the skin that is due largely to the influx of blood that comes from vasomotor changes. This increase divided by the number of degrees increase in the temperature of the blood gives a figure which in simple terms indicates that for every degree rise in the temperature of the blood there is in the temperature of the skin a certain number of degrees rise which is largely a vasomotor origin. In cases of Raynaud's disease indexes of from 5 to 14 are obtained. In the cases of thromboangiitis obliterans with vasoparalytic disturbance indexes of 10 to 15 have been found. The index is of practical importance in the election of cases for operation and the rise in surface temperature that comes with fever approximates roughly that occurring after sympathetic ganglionectomy (Fig. 1 and 2). It also has a certain diagnostic importance in differentiating cases in which the diagnosis of a pure vasomotor disturbance and early organic disease of the arteries is not entirely clear. In arteric chronic disease of the limb the vasomotor indexes are low or zero. In obtaining such an index militates against operation in the sympathetic system.

SUMMARY OF THE DISTURBED MECHANISM IN RAYNAUD'S DISEASE

Our studies give further corroboration of the theoretical explanation of the disturbance in this disease formulated by Raynaud there is overexcitability of the cerebrospinal vasomotor center which explains the symmetric distribution of the disturbance and agents which act on the periphery as cold on the skin can produce stimulation and overactivity of the center. In subjects who exhibit vasoparalytic disturbance there is

exaggeration of the normal tonic activity of the vasoconstrictor mechanism. At first this hyperactivity is intermittent requiring abnormally high degree of stimuli to excite it later it becomes more continuous and more distressing. Excessive vasoconstriction of the peripheral vascular mechanism produces transitory closure of the arterioles capillaries and venules. The changes in color depend in a large degree on the completeness of the spasm. The recovery of the local circulation with the application of increased heat or with increased environmental temperature or in the presence of fever attests to the functional nature of the condition. The cause of the excitability of the vasomotor centers is unknown but it is probable that in some forms of vasomotor disturbance the constitutional factor is paramount.

TREATMENT

The primary objects in the treatment of Raynaud's disease can be considered to be twofold: first to remove if possible the exciting factors second to block or to produce interference in the vasomotor paths which supply the affected areas. In the case of the mild types without pain or trophic disturbances frequently considerable relief is obtained by protection from cold changes of occupation wearing of warmer clothes and warmer covering for the extremities—a factor in this age of limited female apparel—reminiscent of a warmer climate. Frequently cases of the mildest type do not need treatment. If the condition is not progressive if it does not produce serious symptoms and if it merely is disturbing to the patient because of the change in color urticaria and mild degree of protection may be all that is required. In the more severe condition in which the changes in color are more marked and the change in environmental temperature is necessary to cause the paroxysm it has been our experience that the protective measure fail. We have advised a certain group of these patients to live in a warm climate but the condition did not materially improve. It has been found that the variation between the warm day and the cool night gives rise to a severe symptoms as occur with the sharp variation in temperature in

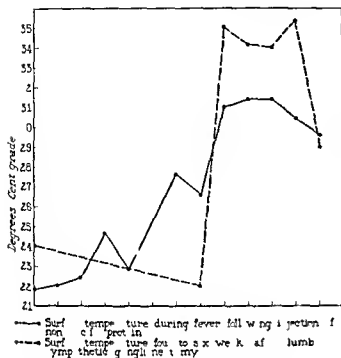


Fig. 1. Surface temperature of left lumbar region following lumbar sympathectomy. Approximation may be noted.

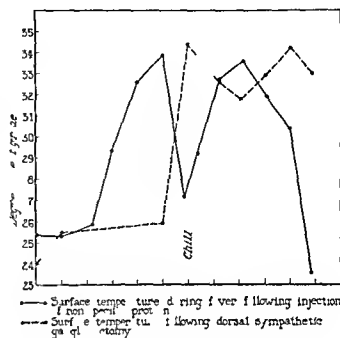


Fig. 2. Surface temperature of hand during fever and following lumbar sympathectomy. Approximation may be noted.

northern latitudes. Occasionally we have noted considerable improvement following fibrile reactions induced by the use of non-specific protein. This can be explained perhaps on a basis of vasomotor paresis resulting from fever. Certainly in one case the color reactions with the accompanying symptoms became almost negligible following a short course of this form of treatment. In other cases we have not observed any effect whatever. The summary of the medical treatment in Raynaud's disease is that on the whole it has been most disappointing. The majority of cases regardless of the institution of any of the foregoing measures has continued to exhibit vasospastic reactions and frequently have progressed to the initiation of mild trophic changes. The disease is a real disability extremely disconcerting to the patient and most trying to the physician.

The second of the two objects in the treatment of Raynaud's disease, blockage of the vasomotor path to the part, has been the goal long sought in the treatment of this disease.

ANATOMY AND HISTOLOGY

Before discussing the specific innervation of the arteries to the upper and lower extremities

we could use a quotation from Ranson's article on Anatomy of the Sympathetic Nervous System so that the reader may obtain a brief but comprehensive review of its relationships:

The sympathetic nervous system is an aggregation of ganglions, nerves and plexuses through which the viscera, glands, heart, blood vessels and smooth muscle in other situations receive their innervation. The most conspicuous feature of the system is a pair of ganglionated nerve cords or sympathetic trunks which extend vertically through the neck, thorax and abdomen. Each sympathetic trunk is composed of a series of ganglions bound together by short nerve strands. Every spinal nerve is connected with the sympathetic trunk of its own side by one or more gray rami communicantes through which it receives sympathetic fibers for the control of blood vessels, sweat glands and smooth muscles of the hair follicles situated within the territory of its distribution. The majority of the nerve fibers taking origin in the ganglions of the sympathetic chain are distributed through the gray rami and the spinal nerve. The ganglions of the thoracic and abdominal portions of the chain are less concerned with visceral activity than with constriction of the peripheral blood vessel, erection of the hair and secretory activity of the sweat glands. But the upper thoracic and cervical ganglions bear a more intimate relation to the thoracic viscera since they contain the cells of origin of postganglionic fibers for these viscera.

The thoracic and upper lumbar nerves are connected with the sympathetic chain by white as well

as gray rami communicantes. These white rami contain both afferent and efferent fibers. The latter take origin from all in the gray matter of the spinal cord travel through the ventral root and white rami and enter the sympathetic system to terminate in sympathetic relation with the nerve cell found in the sympathetic ganglions. They are often designated as preganglionic fibers while those that arise in the ganglions are called the sympathetic nerves and are called postganglionic. The gray rami contain postganglionic fibers the white rami contain preganglionic fibers.

The majority of the preganglionic fibers turn the upper and lower ends of the sympathetic chain into a series of varying distances within it before entering the ganglions. The cervical sympathetic trunk is composed exclusively of preganglionic efferent fibers derived through the white rami from the upper thoracic nerves and ascend to terminate in the cervical sympathetic ganglions. The lumbar and sacral portions of the trunk are composed in the majority of descending fibers derived through the white rami from the lower thoracic and upper lumbar plexuses.

These fibers of the white rami which are concerned with the innervation of the abdominal viscera pass into the plexus nerves and end in the celiac ganglion. These fibers reach the plexus nerves after passing through the lower half of the thoracic sympathetic chain but the ventral rami of the lumbar ganglion through which they pass.

The sympathetic nervous system receives additional fibers from the spinal cord by way of the cervical branches of the third and fourth sacral nerves and from the brain through certain of the cranial nerves.

There are then these three streams of preganglionic efferent fibers: (1) the cranial stream from the third, seventh, ninth and tenth cranial nerves; (2) the thoracic stream from the thoracic and upper lumbar spinal nerves; (3) the sacral stream from the sacral spinal nerves. The cranial and sacral streams belong to the sympathetic system and the thoracic stream to the sympathetic system.

Most of the sympathetic nerves contain additional fibers derived from the sympathetic system which are concerned with the innervation of the viscera to the spinal cord. These sensory fibers have their cell of origin in the spinal ganglion and reach the sympathetic system by way of the white rami. Visceral reflexes therefore travel through at least three neurons each. The impulse reaches the spinal cord, the afferent fibers in the dorsal root and leave the plexus, the visceral efferent fibers enter the sympathetic trunk. The efferent sympathetic ganglions are the impulses which they carry are relayed to voluntary muscle and glandular tissue by postganglionic fibers. The ganglions of the sympathetic trunk do not exercise reflex centers but only relay stations in the

conduction path from the spinal cord to the viscera.

Ranson and Edgeworth have been able to trace and a dog to trace sensory fibers histologically because of their relatively large size through the sympathetic system from the cardiac plexus to the vagus and the three upper thoracic nerves. The fibers to the thoracic nerves were traced through the middle and the inferior cervical and the sympathetic trunk and corresponding white rami of the thoracic spinal nerves. However they did not find any sensory fibers in the cervical sympathetic trunk above the middle cervical ganglion. They believe that it is fair to assume that in man a sensory distribution should exist similar to that which exists in these other mammals.

Kramer and Todd in their study of the distribution of nerves to arteries of the arm stated that with the exception of the subclavian and axillary arteries which receive their innervation direct from the cervical thoracic ganglion its origin corresponds with that of the nerve supply to the skin and muscle areas. Potts in his study on the nerve supply to the arteries of the leg came to the same conclusion. In the light of the results obtained by ramisection section of the trunk ganglionectomy and of the anatomical descriptions of the innervation of the arteries of the extremities we are compelled to believe that in the extremities the vasoconstrictor nerves gray rami and postganglionic fibers enter the spinal nerves and are given off at intervals corresponding with the somatic segments and that the arrangement here differs from that in the thoracic abdominal and cranial cavities where the sympathetic innervation follows the vessels to their distribution.

Since we are interested in breaking these efferent vasoconstrictor impulses of all four extremities we must make sure that the section in the lumbar area is high enough and that in the thorax it is low enough. Inasmuch as the second lumbar ganglion usually receives the last preganglionic white ramus it would be sufficient to divide the sympathetic trunk below this ganglion but since the distribution of rami is not constant and since

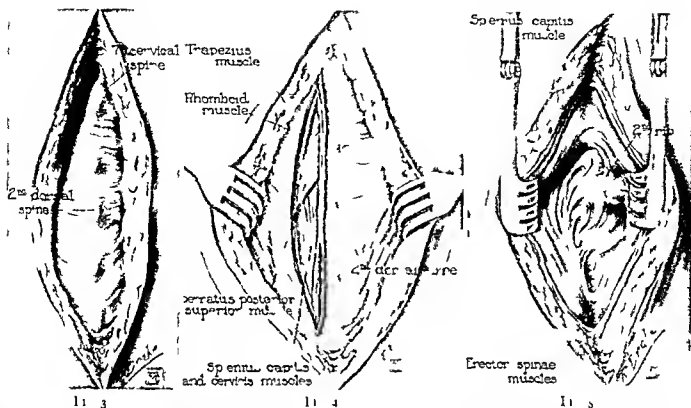


Fig. 3 Exposure secured by the dorsal midline incision.

Fig. 4 Incision in fasci and muscle between the 1st and 2nd dorsal spines thus exposing the anterior layers of the muscles which are encountered in the

approach to the ganglia and the transverse process of the second thoracic vertebra.

Fig. 5 Exposure of the endorhachial and transverse processes of the second thoracic vertebra and the pleuroscapular and pleuroaxillary muscles.

there is a possibility of missing fibers we prefer to resect the lumbar sympathetic trunk including the ganglia *in toto* from above the second lumbar to a point below the fourth ganglion.

In the cervicothoracic area it is important to include the second thoracic ganglion for Kuntz has shown that both this sympathetic ganglion and the second thoracic spinal nerve which carries vasoconstrictor fibers contribute innervation to the lower trunk of the brachial plexus in a high percentage of cases. We grant that if one were sure of dividing all of the gray rami to the subclavian and axillary arteries and to the brachial plexus one could preserve the trunk and ganglia or could divide all the rami to the plexus and arteries together with section of the trunk but when the thoracic trunk is sectioned the cervicothoracic with all of the upper cervical ganglia are thrown out of work since they merely act as relay stations. Therefore we again believe in a thorough resection of the second thoracic and the cervicothoracic

ganglia and the intervening trunk in order to interrupt all vasoconstrictor impulses from the first and second thoracic ganglia directly to the first and second thoracic spinal nerves and arteries in addition to interrupting efferent fibers which pass through the ganglia and trunk into the cervical ganglia to be distributed to the brachial plexus. It is true this procedure will interrupt efferent impulses to the vasoconstrictors of all arteries in the neck and their corresponding distribution. It has and has not produced a complete Horner's syndrome with dilation of retinal vessels.

Since we are discussing the anatomy of the cervicothoracic ganglia a few comments will be made on angina pectoris. Ranson stated that the white rami carry afferent and efferent impulses and that in the cat and the dog he and Edgeworth demonstrated sensory fibers arising from the cardiac plexus through the middle and lower cervical ganglia to the first, second and third thoracic nerves. This means that the efferent impulses through the upper two or three thoracic ganglia and trunk in

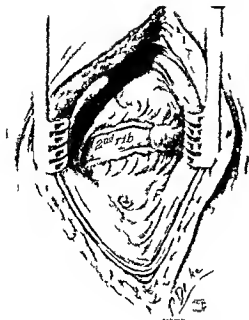


Fig. 5. b. c. d. e. f. g. h. i. j. k. l. m. n. o. p. q. r. s. t. u. v. w. x. y. z. aa. ab. ac. ad. ae. af. ag. ah. ai. aj. ak. al. am. an. ao. ap. aq. ar. as. at. au. av. aw. ax. ay. az. ba. bb. bc. bd. be. bf. bg. bh. bi. bj. bk. bl. bm. bn. bo. bp. bq. br. bs. bt. bu. bv. bw. bx. by. bz. ca. cb. cc. cd. ce. cf. cg. ch. ci. cj. ck. cl. cm. cn. co. cp. cq. cr. cs. ct. cu. cv. cw. cx. cy. cz. da. db. dc. dd. de. df. dg. dh. di. dj. dk. dl. dm. dn. do. dp. dq. dr. ds. dt. du. dv. dw. dx. dy. dz. ea. eb. ec. ed. ee. ef. eg. eh. ei. ej. ek. el. em. en. eo. ep. eq. er. es. et. eu. ev. ew. ex. ey. ez. fa. fb. fc. fd. fe. ff. fg. fh. fi. fj. fk. fl. fm. fn. fo. fp. fq. fr. fs. ft. fu. fv. fw. fx. fy. fz. ga. gb. gc. gd. ge. gf. gg. gh. gi. gj. gk. gl. gm. gn. go. gp. gq. gr. gs. gt. gu. gv. gw. gx. gy. gz. ha. hb. hc. hd. he. hf. hg. hh. hi. hj. hk. hl. hm. hn. ho. hp. hq. hr. hs. ht. hu. hv. hw. hx. hy. hz. ia. ib. ic. id. ie. if. ig. ih. ii. ij. ik. il. im. in. io. ip. iq. ir. is. it. iu. iv. iw. ix. iy. iz. ja. jb. jc. jd. je. jf. jg. jh. ji. jj. jk. jl. jm. jn. jo. jp. jq. jr. js. jt. ju. jv. jw. jx. jy. jz. ka. kb. kc. kd. ke. kf. kg. kh. ki. kj. kk. kl. km. kn. ko. kp. kq. kr. ks. kt. ku. kv. kw. kx. ky. kz. la. lb. lc. ld. le. lf. lg. lh. li. lj. lk. ll. lm. ln. lo. lp. lq. lr. ls. lt. lu. lv. lw. lx. ly. lz. ma. mb. mc. md. me. mf. mg. mh. mi. mj. mk. ml. mm. mn. mo. mp. mq. mr. ms. mt. mu. mv. mw. mx. my. mz. na. nb. nc. nd. ne. nf. ng. nh. ni. nj. nk. nl. nm. nn. no. np. nq. nr. ns. nt. nu. nv. nw. nx. ny. nz. oa. ob. oc. od. oe. of. og. oh. oi. oj. ok. ol. om. on. oo. op. oq. or. os. ot. ou. ov. ow. ox. oy. oz. pa. pb. pc. pd. pe. pf. pg. ph. pi. pj. pk. pl. pm. pn. po. pp. pq. pr. ps. pt. pu. pv. pw. px. py. pz. qa. qb. qc. qd. qe. qf. qg. qh. qi. qj. qk. ql. qm. qn. qo. qp. qq. qr. qs. qt. qu. qv. qw. qx. qy. qz. ra. rb. rc. rd. re. rf. rg. rh. ri. rj. rk. rl. rm. rn. ro. rp. rq. rr. rs. rt. ru. rv. rw. rx. ry. rz. sa. sb. sc. sd. se. sf. sg. sh. si. sj. sk. sl. sm. sn. so. sp. sq. sr. ss. st. su. sv. sw. sx. sy. sz. ta. tb. tc. td. te. tf. tg. th. ti. tj. tk. tl. tm. tn. to. tp. tq. tr. ts. tt. tu. tv. tw. tx. ty. tz. ua. ub. uc. ud. ue. uf. ug. uh. ui. uj. uk. ul. um. un. uo. up. uq. ur. us. ut. uu. uv. uw. ux. uy. uz. va. vb. vc. vd. ve. vf. vg. vh. vi. vj. vk. vl. vm. vn. vo. vp. vq. vr. vs. vt. vu. vv. vw. vx. vy. vz. wa. wb. wc. wd. we. wf. wg. wh. wi. wj. wk. wl. wm. wn. wo. wp. wq. wr. ws. wt. wu. wv. ww. wx. wy. wz. xa. xb. xc. xd. xe. xf. xg. xh. xi. xj. xk. xl. xm. xn. xo. xp. xq. xr. xs. xt. xu. xv. xw. xx. xy. xz. ya. yb. yc. yd. ye. yf. yg. yh. yi. yj. yk. yl. ym. yn. yo. yp. yq. yr. ys. yt. yu. yv. yw. yx. yy. yz. za. zb. zc. zd. ze. zf. zg. zh. zi. zj. zk. zl. zm. zn. zo. zp. zq. zr. zs. zt. zu. zv. zw. zx. zy. zz.

In addition to the middle and inferior cervical ganglia in order to reach the spinal nerves. Therefore since so many operations on the cervicothoracic ganglia have failed to give relief in true angina pectoris it is fair to assume that the operation was not complete and that some of the sensory fibers from the heart were not divided. According to Ranson the sensory afferent impulses which reach the brain from the heart by way of the vagus probably rarely give rise to pain but expend their energy in the production of reflexes. The example he gives is the lowering of blood pressure on stimulation of the vagodepressor fibers which end in the arch of the aorta. Assuming that the surgical indications are suitable that we are dealing with a true organic angina pectoris and that the surgeon desires to be positive in the relief of the pain to the left side of the chest and the left arm it will be necessary to carry out a more complete left anterior dissection or to adopt the posterior approach with complete interruption of afferent fibers to the upper five thoracic nerves by complete removal of the lower cervical and first and second thoracic ganglia. In a few instances it may be necessary even to

include the thoracic trunk and the fourth and fifth thoracic ganglia. One might choose to section these afferent sensory fibers from the heart through a laminectomy which would be a procedure of less magnitude than a bilateral thoracic ganglionectomy would be. Of course many of the patients suffering from an angina pectoris are considered very poor surgical risks and therefore one naturally must follow conservative medical measures (paravertebral alcoholic injection) and resort to the more extensive operations only in severe cases.

It is our impression that the problem of angina pectoris might be approached surgically in two ways: the first, an attempt to relieve the vasoconstriction of the coronary arteries by sectioning the vasoconstrictor fibers entering the cardiac plexuses through the superior cervical cardiac nerve which receives its afferent fibers from the superior cervical ganglion; the second, an attempt to interrupt the afferent pain sensations which are due probably to organic disease of the arteries and cardiac musculature and not attributable to vasoconstriction of the coronary arteries. The first of these two methods may bear a relation to the phenomenon present in Raynaud's disease and the second to the phenomenon of endarteritis obliterans of the extremities.

Davis and Kanavel presented a very good review of literature concerning the physiology of the vasoconstrictor phenomena of arteries and arterioles. It will suffice to say that the accepted opinions are that the gray rami from the thoracic or lumbar ganglia enter the spinal nerves as non-medullated fibers and are distributed according to somatic segment and control to a great degree the tone of the arteries and arterioles and determine their size and caliber. Even though the vasoconstrictor nerve has been paralyzed there still exists tone in the musculature of the artery. According to Bayliss the tone is controlled by the vasodilator impulses which travel antidromically along the sensory fiber. Davis and Kanavel believe that it is just as fair to assume that the phenomenon of vasodilatation is not entirely dependent on the periarterial sympathetic innervation and that probably there is very little dependent on any such innervation of the blood vessel wall. They believe fur-

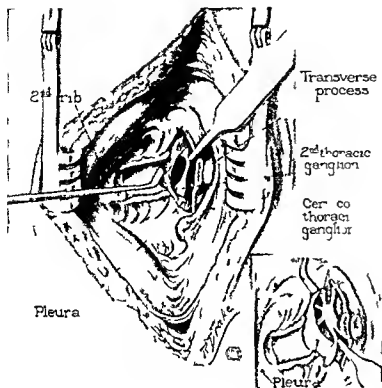


Fig. 1. Exposure of the second thoracic and cervicothoracic ganglia with only a small portion of the second thoracic ganglion in the field. The method by which the second thoracic ganglion is elevated by traction preliminary to resection of the thoracic trunk below the ganglion is illustrated. The procedure is shown by which the cervicothoracic ganglion is drawn down and to expose the various communicating branches. In this particular case the lower cervical portion of the cervicothoracic ganglion is separated from the thoracic portion by a dense band.

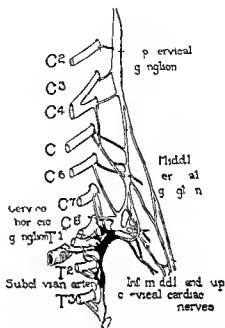


Fig. 2. The relations between the thoracic and cervical ganglia, the subclavian artery and the cardiac plexus are shown. The darkened portion illustrates that section of the sympathetic trunk and the ganglia which are definitely removed. Occasionally the cervical portion also may be removed.

ther that it is equally as definite that these phenomena regularly are obtained through the agency of purely motor purely sensory or through mixed nerves of cerebrospinal origin.

From our clinical results we are compelled to believe that the vasoconstrictor fibers play a tremendous role in producing the vasomotor spasms and that when they are cut they prevent further spasm of the arteries and arterioles and permanently increased surface temperature is developed. It is rather difficult to explain the sudden disappearance of pain following resection of a sympathetic ganglion. It is possible even in the lumbar area that we divide afferent fibers in the gray rami on their return through the ganglia and white rami to the spinal cord and that the arrangement in this area is somewhat similar to the sensory sympathetic arrangement described by Brownson for the cardiac plexus. However we are

more inclined to believe that the pain in the extremities in a large percentage of cases is relieved by improved peripheral circulation.

Probably Davis and Kanavel are partially correct since the cerebrospinal motor nerves may act as auxiliaries to the vasoconstrictor nerves and the sensory fibers may carry sensations of pain directly to the spinothalamic tracts of the cord.

OPERATIVE MEASURES

In the effort to relieve vasomotor spasm of the vessels in diseases that produced painful trophic and gangrenous changes in the extremities Jaboulay is accredited with developing the operation of periarterial sympathectomy. The procedure did not gain much prominence until Leriche (6) in 1913 revived the operation and since has used it in a large and varied group of vasomotor disturbances. His endeavors have encouraged many surgeons to try the procedure. Although the operation of periarterial sympathectomy is local in its effect and has questionable

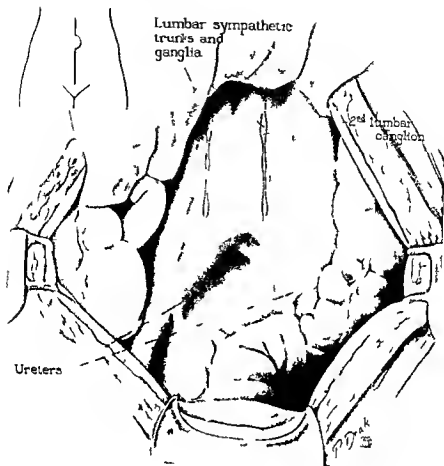


Fig. 1. The ganglion of the lumbar sympathetic trunk and ganglia. The ureters are shown in the dissection.

evidence for its existence since the nerve supply to the artery is segmental in its distribution it is curious that Leriche (7) Muller (1) and many others have secured partial or complete cures following periaxillary sympathectomy for Raynaud disease and the healing of trophic indolent ulcer while others have met with failure or have obtained very incomplete temporary result (8, 9). The conception that the vasoconstrictor nerve of the arteries may be paralyzed by dividing or removing the sympathetic innervation as presented by Leriche has stimulated other surgeons to develop more extensive operation. They have divided the gray rami removed sympathetic ganglia and divided the sympathetic trunk in order to interrupt postganglionic fibers before they enter the spinal nerve to be distributed

to the various sections of arteries corresponding to the spinal nerve innervation.

Poye (34) in his report of January 26, 1940 on "The Treatment of Spastic Paralysis by Sympathetic Laminectomy" made the comment on examining the patient 6 hours after the operation that he noticed that the right leg, the side operated upon, was brighter in color than the left leg, that it felt warmer and gave evidence of capillary dilatation. He however was unable to demonstrate any difference in temperature with an ordinary clinical thermometer.

From May 10, 1940, the date of our first abdominal transperitoneal lumbar sympathetic ganglionectomy for spastic paralysis, we have observed the same phenomena that Royle described but we proceeded at once to measure these changes by the thermocouple

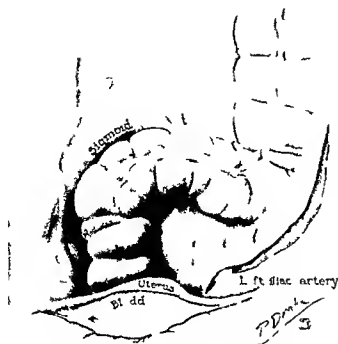


Fig 10 The incision in the lower left posterior peritoneum is employed to reflect the peritoneal pouch permitting elevation and retraction to a distal median line of the sigmoid and descending colon

and the hand or foot calorimeter. When it became evident that the surface temperature of the feet remained elevated for months and when there was evidence that it would remain so permanently we concluded that we would be justified in trying the procedure in a case of Raynaud's disease. This we did March 19 1925 and we (1) reported the case 3 months later. The relief of symptoms in the patient whose case was reported was so dramatic that we were almost afraid to believe our eyes. This patient and the other patients on whom we performed lumbar sympathetic ganglionectomy for Raynaud's disease have continued to be relieved following operation. Therefore we confidently can say that the pain is relieved the abnormal color reactions disappear the feet and legs present a pinkish color are dryer and definitely warmer than before operation and there is an average sustained increase in surface temperature of 1 C.

Diez in 1903 advocated for trophic and gangrenous conditions resection of the lumbo-sacral cord removing the second lumbar ganglion and the ganglia and trunks down to and including the third sacral ganglion. He re-

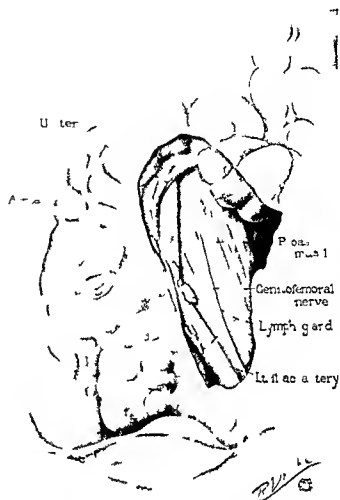


Fig 11 Further elevation of the peritoneal pouch to the left exposing the pelvic plexus the geniofemoral nerve the ilio-lumbar and the common iliac artery previous to the exposure of the lumbar ganglia

ported that he carried out this procedure for the first time July 24 1924. Diez and we were quite unaware of the fact that in our separate ways we were trying to accomplish the same result in a rather similar way. Koyle's criticism of our periaxillary neurectomy of the common iliacs in conjunction with the operation on the sympathetics is justified and that phase of the operation was dropped before his criticism appeared in print. It was originally employed to make the operation more complete thus not only interrupting the postganglionic fibers to the spinal nerves but also breaking sympathetic fibers to the iliacs from the pelvic plexus. However we soon learned that if on one side we did unilateral periaxillary neurectomy in addition to lumbar sympathetic ganglionectomy and on the



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ganglionic fibers (white rami communicantes) enter the second lumbar sympathetic ganglion.

So far we have not seen any untoward result from the removal of the lumbar ganglia. Davis and Kanavel (June 20, 1916) presented a very comprehensive study on sympathectomy in Raynaud's disease, erythromelalgia and other vascular disease of the extremities. They reported on five cases but completely on only two. One of the two was a case of erythromelalgia of the feet in which operation was done April 29, 1923. In this case they employed the abdominal transperitoneal approach which they first described in the same general discussion on lumbar sympathectomy wherein we described our abdominal approach to the lumbar sympathetics. The occasion of this discussion was the meeting of the Clinical Congress of the American College of Surgeons in New York in October, 1924 following address by Rowle (3) and Hunter. The second case reported by Davis and Kanavel was a true case of Raynaud's disease of the upper extremities in which operation was done January 29, 1916 and the right cervical sympathetic chain and stellate ganglion were removed. The postoperative notes and color plates raise two points worthy of discussion. In the first case that of erythromelalgia there is presented a history and color change similar to those which occur in thromboangitis obliterans and the patient responded postoperatively very much as many patients with thromboangitis obliterans whom we have seen. The fact that the dorsalis pedis and posterior tibial arteries were palpable and open naturally suggested the diagnosis of erythromelalgia but occasionally we see patients with early symptoms of thromboangitis obliterans in whom there is involvement of the peripheral arteries distal to the point where we are able to palpate the dorsalis pedis and the posterior tibial arteries. In thromboangitis obliterans there exists free the collateral ganglion
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Fig. 13 The incision on the right side similar to that on the left side which is illustrated in Figure 5

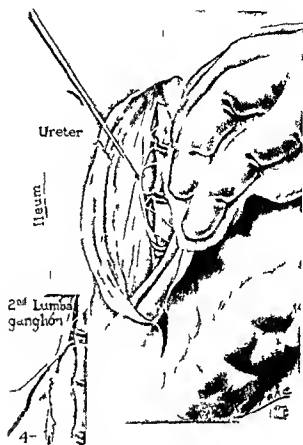


Fig. 14 Exposure and resection on the right side similar to that on the left side which is illustrated in Figure 10

employed in patients with a vasomotor spasm which is capable of relaxation by fever that is induced by the injection of foreign proteins. It should be employed also in patients with more or less quiescent thrombotic processes. In the second case reported by Davis and Kanavel the color plate illustrating the condition following the cervicothoracic ganglionectomy suggested an incomplete result. With an incomplete result cyanosis would recur in distal parts of the phalanges and in the illustration there was cyanosis in this region. Incompleteness is common with the operation as it is carried out through the anterior approach. We achieved the same result in a patient on whom we operated for Raynaud's disease of the upper extremities March 2, 1925. We never have succeeded in securing so perfect a result with the cervicothoracic ganglionectomy by the anterior approach as we did with the lumbar ganglionectomy in the treatment of Raynaud's disease, all of which means that the efferent fibers to the blood supply of the

arm and hand were incompletely divided. Our own experience and the reports of others aroused us sufficiently finally to adopt a posterior intrathoracic approach and this is successful.

Royle (38) in 1917 reported on eight patients operated on for vasomotor disturbances; four had Raynaud's disease and four thromboangitis obliterans. The results confirm the study of temperature changes already given.

Fulton in 1918 presented a very thorough study of a patient with Raynaud's disease. The disease was bilateral and involved the hands as well as the feet. In order to have controls only one side was operated on. On the right side the Royle cervicothoracic ramisection was performed and was followed immediately by a Royle ramisection of the right second, third, and fourth lumbar ganglia in conjunction with division of the lumbar sympathetic trunk. Fulton's studies on this patient over a period of one year demonstrated complete relief of symptoms in the



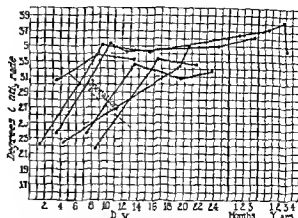
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right foot and leg but no relief of symptoms in the right upper extremity. His experience was in absolute accord with our experience in the treatment of Raynaud's disease until we began to use the posterior intrathoracic approach to the upper two thoracic ganglia. This permitted us to resect the second thoracic and the cervicothoracic ganglia and the intervening trunk. In this way we believe we interrupted completely all efferent vasoconstrictor impulses to the vessels of the upper extremities which gave us the same result that previously was obtained by lumbar sympathetic ganglionectomy.

Before proceeding with the description of the surgical technique used by one of us (Adams) it might be of interest to review briefly the history of the cervicothoracic gan-



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Surface temperature of feet before and after lumbar ganglionectomy. Raynaud's disease. Initial point is an average of 2 to 6 readings on different days before operation.

ganglionectomy as carried out through the anterior approach. Jonnesco called attention to the fact that resection of the stellate ganglion (which is the cervicothoracic) with or without resection of the middle and upper cervical ganglia first was done in 1896 for epilepsy and exophthalmic goiter later by other surgeons for migraine and glaucoma. In 1906 Jonnesco followed a suggestion made by Trincors Link and performed his operation for the relief of angina pectoris which was successful from that period until recently the operation has been used by scores of surgeons for almost every conceivable ailment of the head, neck, and upper extremities. The frequent relief of angina pectoris by resection of the cervicothoracic ganglion has justified the procedure.

This discussion does not permit a review of the surgery of angina pectoris. In 1906 Bruening resected the cervicothoracic ganglion for Raynaud's disease and for scleroderma. Davis and Kanavel in 1906 presented a very thorough review of the anatomy and physiology concerning the vasoconstriction seen in Raynaud's disease and included drawings illustrating the technique used by them. But when it came to judge by comparison of the results before and after operation the anterior approach with resection of the stellate ganglion was insufficient completely to interrupt all

impulses to the vessels of the upper extremities. This discussion does not permit a review of the surgery of angina pectoris. In 1906 Bruening resected the cervicothoracic ganglion for Raynaud's disease and for scleroderma. Davis and Kanavel in 1906 presented a very thorough review of the anatomy and physiology concerning the vasoconstriction seen in Raynaud's disease and included drawings illustrating the technique used by them. But when it came to judge by comparison of the results before and after operation the anterior approach with resection of the stellate ganglion was insufficient completely to interrupt all

efferent sympathetic fibers to the vessels of the finger tips

In 1908 Royle (39) in a treatise on section of the sympathetic trunk for Raynaud's disease and spastic paralysis reported a case of Raynaud's disease of the upper extremity in which he had performed years previously a Royle rhizotomy. This had been without success and then he had reoperated through the new approach which differs from that of Jonnesco.

Royle reflects the clavicular attachment of the sternocleidomastoid and divides the tendinous attachment of the scalenus anticus in order to secure better exposure of the stellate ganglion then he divides the thoracic trunk below the cervicothoracic ganglion with satisfactory results. On the other side a month later he resects the thoracic trunk with successful results. These operations were performed May 24, 1928 and July 3, 1928. We feel sure that his latest suggestion has offered the best anterior approach to the cervicothoracic ganglion. We are familiar with this field as we have used this approach and have described it previously in connection with the treatment of the symptoms arising from the presence of cervical ribs. We agree with Royle (39) also in his statement that work in this surgical field is fraught with dangers and that previous failures were due to incomplete operations. However we disagree with him in his satisfaction with section of the thoracic trunk below the stellate ganglion for Kuntz has shown that the second thoracic ganglion contributes gray fibers to the first thoracic spinal nerve as well as to the second thoracic spinal nerve and this in turn often contributes to the lower trunk of the brachial plexus. We have been able also at the operating table working through the posterior intrathoracic approach to substantiate Kuntz findings.

It pleases us that Royle (39) recognized the importance of section of the trunk. We have advocated it right along in our lumbar sections and again in the procedure which we (2) have developed recently in effecting complete interruption of efferent sympathetic fibers to the subclavian and axillary arteries and to the brachial plexus.

All of the more or less partial or incomplete results in the treatment of vasoconstrictor disturbances of the upper extremities when sections of the stellate ganglion were done by the anterior approach convinced us that some other approach was necessary. Royle's recent operation offers one solution but we were unaware of his new procedure when July 31, 1928 we first resected the second thoracic and cervicothoracic ganglia and the intervening trunk through the posterior intrathoracic approach. We did not receive Royle's (39) reprint until 3 months later.

Therefore the problem that confronted all of us was to find a procedure that would permit complete removal of the second thoracic and cervicothoracic sympathetic ganglia and the intervening trunk in order completely to break all sympathetic impulses to the subclavian and axillary arteries and to the brachial plexus. It appeared that the posterior approach was the logical procedure and was the method we believed necessary when we failed in our first attempt to relieve Raynaud's disease of the upper extremities. The ramus from the ninth, tenth, eleventh and twelfth thoracic ganglia had been sectioned through a dorsal approach for a neuropathic condition of the abdomen by von Graw in 1924. In groping about in medical literature for information concerning the exact anatomy of this field our attention was called to Henry's essays on Exposure of Long Bones and Other Surgical Methods. One of these essays was on an anatomical dissection of the cervicodorsal ganglion from the posterior approach and had the title "A New Method of Resecting the Left Cervico Dorsal Ganglion of the Sympathetic in Angina Pectoris."

This evidence was sufficient to convince us that we could resect the second thoracic ganglion, the cervicothoracic and the intervening sympathetic trunk and thus we could completely interrupt all of the efferent fibers to the vessels of the arm as well as those to the head and neck. In our first case the procedure was divided into two operations: resection of the second thoracic ganglion, the cervicothoracic ganglion and the intervening sympathetic trunk on right side July 31, 1928 and on left side September 11, 1928.

Inasmuch as it was necessary to perform bilateral operations we had to depart from Henry's suggestions concerning skin and muscle flaps. Furthermore in accordance with Kuntz' anatomical suggestion we believed it necessary to include the second thoracic ganglion and ramus. Therefore it was necessary to enlarge the scope of the operation and this would be necessary too probably if one were to break all afferent impulses from the heart to the brachial plexuses in order to relieve all referred pain to the arms and chest wall.

SURGICAL TECHNIQUE FOR THE REMOVAL OF THE UPPER THORACIC GANGLIA

After the patient is anesthetized he is placed in the prone position on two soft pillows. The arms are permitted to hang down over the edge of the table to allow retraction of the scapula outward and forward. The neck is flexed forward and the head is supported by an Adson-Little cerebellar head rest. Thereafter administered by the inhalation method with an open mask attached to the head rest. The incision in the skin is made in the median line from the tip of the sixth cervical vertebra to the tip of the fourth dorsal spine. The incision is carried down to the fascial planes thus exposing the fascia over the trapezius on both sides. The fascial muscle incision is made on each side and parallel with the spinous processes extending from the seventh cervical vertebra to the fourth dorsal vertebra. The procedure at this point is carried to completion on the side to be operated on before muscle dissection on the opposite side. The fascial muscle incision is made first through the tendinous attachment of the trapezius to the spinous process and subsequently through the spinous attachment of the rhomboid and serratus posterior. Then the retractors expose the erector spinae group and the lower end of the splenius cervicis. The transverse process of the dorsal vertebra can be palpated through the muscle. After one has made sure that the transverse process of the second dorsal vertebra has been identified as well as the tip of the transverse process of the second dorsal vertebra a blunt dissection is made through the

erector spinae group parallel with the spinous processes. The retractor is placed at a deeper level and opposite the transverse process of the second dorsal vertebra. Muscular attachment to the transverse process are now freed carefully until one can demonstrate the process where it fuses with the body and the lamina. The periosteum of the rib is incised on its dorsal aspect. This permits exposure of the rib lateral to the transverse process for a distance of 3 centimeters. The rib is cut at the outer border of this area of exposure and the transverse process is cut where it joins the body of the vertebra. Occasionally one may have difficulty with the intercostal artery but this can be ligated care being taken not to injure the first or second thoracic nerves. The pleura and lung are now gently dissected from the lateral side of the vertebra and are retracted anteriorly and laterally. This procedure in turn will expose the sympathetic trunk between the second thoracic and the cervicothoracic sympathetic ganglia. The trunk lies at a level corresponding to the articulation of the head of the second rib. After exposure of the sympathetic trunk the procedure consists in the dissection and the removal of the ganglia and the intervening trunk elevating and resecting the second thoracic ganglion dividing any gray rami that may run laterally from the second thoracic ganglion to the first thoracic nerve. After the second thoracic ganglion has been elevated and the sympathetic trunk has been divided below traction on the sympathetic trunk is now made from above downward thus exposing the cervicothoracic ganglion. This exposure is done by first dividing the ansa subclavian ramus and subsequently dividing the ramus as they pass off to the first thoracic spinal nerve. The maneuver permits gradual mobilization of the ganglion of the thoracic chain and finally retraction of the cervicothoracic ganglion sufficiently to divide all of the rami ascending from the ganglion into the cervical region (Fig. 5 to 8).

SURGICAL TECHNIQUE FOR THE REMOVAL OF THE LOWER GANGLIA

The incision is made from the symphysis to a point 5 to 7 centimeter above the umbilicus

between the rectus abdominis muscles and to one side of the umbilicus. The sheath of the rectus muscle subsequently is opened on each side below the umbilicus and on the left side above the umbilicus facilitating closure along anatomical lines. If the abdomen is extremely flaccid it may be advisable to make an overlapping closure (C. H. Mayo type) in the external leaves of the fascia of the rectus abdominis. Before the peritoneum is opened the patient is lowered from the horizontal position to the Trendelenburg position thus insuring better exposure of the lumbar sympathetic ganglia. Although general exploration may reveal other abdominal lesions they are not disturbed at this time since it is desired to avoid the additional risk of contamination. The intestines are pulled upward as they are when hysterectomy is done. It is immaterial whether the ganglia are approached first on the right or on the left side. Usually the ganglia of the right side are more difficult to approach because of the intravertebral veins which run anteriorly and across the sympathetic trunk. To elevate the inferior vena cava is more difficult than to elevate the abdominal aorta and the common iliac artery on the left.

In the exposing of the left lumbar sympathetic chain it is necessary to loosen and elevate the sigmoid and the lower portion of the descending colon. This is done by incising the peritoneum superior and just lateral to the anterolateral border of the upper portion of the sigmoid and the attachment of the lower portion of the descending colon. When the line of cleavage is once started the large bowel can be elevated readily and can be retracted with the posterior wall of the peritoneum beyond the median line. This exposes the retroperitoneum the ureter (as it courses over the bifurcation of the common iliac) the left common iliac artery and vein the lower end of the abdominal aorta the genitocrural nerve (which perforates the psoas muscle) the psoas muscle the lumbar vertebra the lymph nodes and the lumbar sympathetic ganglia trunk and rami which lie on the lumbar vertebra just mesial to the psoas muscle. The ureter on the left side is more easily retracted mesially than laterally. With a moist sponge

it is held gently together with the colonic mesentery the upper end of the sigmoid and the lower end of the descending colon in position in the median line. The abdominal aorta is elevated and is retracted mesially by traction with a finger on a gauze sponge. It is held by an assistant. The sympathetic ganglia trunks and rami are then dissected free by a wet cotton ball dissector held in thumb forceps. It is well to begin at one or the other end of the lumbar sympathetic chain. On the left side it is preferable to expose the fourth lumbar ganglion at the brim of the pelvis and to divide the sympathetic trunk below it. All of the rami including those to the spinal nerves the hypogastric plexuses and the aortic plexuses are then divided. The dissection is then carried upward to include the third and second lumbar sympathetic ganglia. Undue traction should not be exerted on any of the tissues handled especially the mesentery leading to the sigmoid and colon so as to avoid the possibility of rupture or thrombosis of arteries or branches of arteries which supply the large bowel.

The approach to the lumbar sympathetic ganglia on the right is similar to that on the left except that the peritoneal incision is made just lateral to the right lateral border of the abdominal vena cava and is carried downward over the right common iliac vein into the true pelvis upward and mesially along the root of the mesentery of the small intestine partially across the vena cava for a distance of 15 centimeters from the brim of the pelvis and downward into the pelvis for a distance of 5 to 7 centimeters. The cecum the small intestine and the ureter are retracted outward and upward. The vena cava is retracted mesially and the common iliac vein downward and mesially. In the posterior wall of the peritoneum just above the brim of the pelvis on the right side several small veins may be encountered which can be divided and ligated. The further exposure and the removal of the lumbar sympathetic ganglia and division of all of the rami and the sympathetic trunk are similar to the procedures employed on the left side. However the fourth lumbar sympathetic ganglion on the right side usually lies underneath the

TABLE 1—SURVIVAL TEMPERATURES PRECEDING AND FOLLOWING LUMBAR SYMPATHETIC GANGLIOTOMY

| | | T m | | | | D C | | | | R d | | | | | | | |
|--|-------|------|---------|-----|-----|-------|-------|-----|-----|--|--|--|--|--|--|--|--|
| | | R h | | | | I ft | | | | C m m t | | | | | | | |
| | | Th h | L g | F t | T | Th gh | L g | f | Toe | | | | | | | | |
| | 7 | | 5 | | | 5 | 3 | | | F o l l y | | | | | | | |
| | | | 3 | | 3 | 4 3 | | | | L m h l m | | | | | | | |
| | | 5 3 | | | 6 | 4 | 4 5 | | 3 | F w m l l y | | | | | | | |
| | 8 | | | | | | 3 | | 5 | | | | | | | | |
| | 7 | 7 | | 9 | | | | 7 8 | 4 | F t l l l d | | | | | | | |
| | | | | | | | | 4 7 | | | | | | | | | |
| | 7 | | | | | | | | | L b g l m | | | | | | | |
| | | | | 7 3 | | | | | 35 | | | | | | | | |
| | 5 | | 6 3 8 | 5 | 34 | 4 3 | 34 5 | 34 | | F t m l d y | | | | | | | |
| | 5 | | | | 7 | | 31 | 34 | | | | | | | | | |
| | 6 | 5 | 5 6 | 6 | 35 | 3 8 | 35 8 | 6 6 | | | | | | | | | |
| | 7 | | | 6 | 37 | | 37 | 37 | | F h w d a s t m p e d
l d s look q m l | | | | | | | |
| | 8 | | 3 | 5 | | 3 9 | 3 | 5 | | | | | | | | | |
| | | | 8 | | | 33 5 | 3 3 | 3 | | M k d m m l i n g f f d | | | | | | | |
| | | | 3 3 | | | 3 | 3 3 | 3 | | | | | | | | | |
| | | | 8 5 | | 5 | 8 | 35 6 | 35 | | L m b l m y | | | | | | | |
| | | 7 | 8 3 6 | 3 5 | 8 | 3 7 | 31 | | | F t m l l y | | | | | | | |
| | | | 8 3 | | | 3 | 4 5 | 5 | | N m l l l h w f w m l l a s
l f f m p f | | | | | | | |
| | 0 | 6 | | 6 | 4 | | 6 | 3 | | F k l d d l o d m l h | | | | | | | |
| | | | 7 | 7 3 | | | | 3 | | | | | | | | | |
| | | | | | | | | | | L m b g q l m y | | | | | | | |
| | 8 | | 6 3 8 | 33 | | 33 3 | 3 | 3 | | F t m d y d l h | | | | | | | |
| | | | 3 | 5 | | | 35 | 3 8 | | | | | | | | | |
| | 3 8 | 3 7 | 3 7 3 3 | 3 | 6 3 | 3 6 | | | | T h d d g | | | | | | | |
| | 0 | 5 | 9 | 5 5 | 3 | 8 6 | 5 | 5 | | C l d c y f t d o o m m p e | | | | | | | |
| | | | 8 6 | 6 | | 3 6 | 6 | 3 | | | | | | | | | |
| | | 3 | 3 7 | 4 | 9 | 9 6 | 7 7 | 5 | | | | | | | | | |
| | 0-8 | 7 | 3 | 7 5 | 5 | | 9 3 | 7 8 | 6 | | | | | | | | |
| | 0- | | | | | | | | | L m l g l t m | | | | | | | |
| | | | | | 3 7 | 3 | 3 | | | F d r f m k d l y m | | | | | | | |
| | | 5 | | | 3 | | | 3 5 | | P l a d s a p l | | | | | | | |
| | | | 9 | | 3 | | 9 | 8 | 5 | F m l | | | | | | | |
| | 7 | 5 | 8 | | 3 9 | | | | 5 | V y d y | | | | | | | |
| | 8 | | | 7 7 | 5 | | | | 5 | M k d c y o s | | | | | | | |
| | 5 | | | | | | | | 5 | E v e l l l f | | | | | | | |
| | | | | | | | | | | L m b l m | | | | | | | |
| | 8 8 7 | | | | | | 9 6 | 5 | | | | | | | | | |
| | | | | | | | 7 3 4 | | | | | | | | | | |
| | 9-3 8 | 5 | 3 6 | | 5 5 | 9 6 | 3 | 3 8 | | F m l l i w m | | | | | | | |

intravertebral vein and not superficial the retro as it does on the left side

The closure consists in accurate apposition of both retroperitoneal incisions to prevent retroperitoneal hernia and accurate closure of the abdominal wall to prevent the more common type of postoperative hernia (Figs 9 to 13)

EFFECTS OF LUMBAR GANGLIONECTOMY IN SIX CASES OF VASOMOTOR DISTURBANCES OF THE SPASTIC TYPE RAYNAUD'S DISEASE AFFECTING THE FEET

CASE 1 The patient was a Russian Jewish school girl aged 16 years who for the last 8 years had noticed that during the cold weather the feet became white then intensely cyanotic and swollen. Associated with these symptoms was pain which radiated from the feet to the knees and had increased in severity in the last 2 years. Pulsations were present in the vessels of the feet with the exception of the left dorsalis pedis the absence of detectable pulsations in this artery was due we thought to swelling of the tissues. During the attacks there was definite swelling of the feet which in the last few months had remained continuously. There was no evidence of diminished circulation when the feet were elevated. Ulcers were present over both malleoli and on the fifth right toe. The diagnosis was Raynaud's disease of fairly advanced type. Lumbar ganglionectomy was carried out March 19 15 following this the feet became hot and dry with excessive scaling of the plantar surfaces. The ulcers healed within 10 days and the pain entirely disappeared (Table I). A report from the patient one year later stated that the feet remained hot and dry had a normal appearance and with the exception of a little swelling at the back of the heel she felt that the feet were quite normal. She stated that there had been mild symptoms of a similar disturbance in the hands.

CASE 2 The patient was an American aged 5 years a school teacher who for 6 years had had a gradually progressing change in color of the hands and feet. For the year preceding admission to The Mayo Clinic the color changes in the feet were so profound and the condition so painful that during the winter months it was impossible for her to remain outdoors for any length of time. On examination pulsation in all the palpable vessels of the hands and feet was diminished but present. At ordinary room temperature there was extreme cyanosis of the feet associated with marked continuous dull aching pain. Lumbar ganglionectomy was carried out November 7 1925. There was no pain along the sciatic nerve or hyperesthesia of the skin in the legs after the operation. Since this patient lives in Rochester she has been carefully observed for a period of 3 years. During this time her feet have remained warm and dry and the abnormal color

reactions have entirely disappeared. Chilling of the body does not produce appreciable change in the surface temperature of the feet. There has been maintained relief of the condition in the feet for the three year period of observation (Table I). The disease in the hands gradually had progressed in spite of the fact that left cervical ganglionectomy and perivascular neurectomy on the axillary artery had been done. Following the successful results of dorsal ganglionectomy in Case 5 a similar procedure was carried out on this patient and the results are described in the subsequent pages.

CASE 3 This patient was aged 22 years a clerk who entered The Mayo Clinic May 21 1926. The history of her trouble dated back more than 5 years. Following an attack of influenza she had appendicitis and operation was followed by infection of the wound. Every summer following this her feet would become swollen and the normal contour of the ankles would be lost. During the cold weather she had attacks of cyanosis and coldness in the feet there was no history of blanching. Her subjective complaint was of burning worse in the summer but not clearly associated with increased surface temperature of the feet and coldness and lividity during the winter months associated with dull aching sensations. At examination the patient was found to be a well nourished young woman with patchy livid areas in the skin of the feet ankles and calves bilateral and fairly symmetric. A sharp decrease in surface temperature was appreciable in the middle of the legs and the temperature rapidly diminished to the distal portions of the feet. The fingers were cold but there were no color changes with varying temperatures. The subjective symptoms had reached such a degree that it constituted a disability. The vessels of the feet and hands were open with apparently normal pulsations. The neurologic examination was essentially negative. The diagnosis in this case was not entirely clear phlebitis chilblains and a spastic atypical vasomotor disturbance were considered. The thermometric studies showed that the areas of lividity had a surface temperature of 1 to 1.5 degrees Centigrade less than the surrounding skin. In response to injections of non-specific protein there was a sharp increase in the surface temperature and a fairly high vasomotor index. During the height of the febrile reaction she complained of burning in the feet. The final diagnosis was that of vasomotor neurosis of the spastic type associated with non pitting edema and atypical pains in the feet. Operation was carried out June 12 19 6 bilateral lumbar ganglionectomy was done. One month later examination showed increased pulsations of the vessels and the feet were warm and dry associated with mild symptoms of burning. The areas of lividity still persisted in the lower part of the leg but had entirely disappeared from the feet. The measurements of the extremities showed a decrease since operation of 3 centimeters in the circumference of the calf and 2 centimeters in the circumference of the ankle. Table I shows the increases in the surface

There were no untoward results of the operation no paresthesias or nerve tenderness could be elicited. This patient was then discharged with complete relief of Raynaud's disease of the four extremities (Fig. 16 frontispiece).

CASE 6 A woman stenographer aged 31 entered the Mayo Clinic April 6 1928. She gave a history of having had cold feet for many years in that the condition gradually had become worse during the last 5 years without the appearance of noticeable color changes. For the last years she had noticed that the feet became markedly cyanotic during period of cold weather the distribution of the cyanosis was symmetric and involved all the toes and the distal parts of the feet. With increase in the local temperature the feet would become red hot and burning. There was an increasing tendency for the attacks of cyanosis to become more prolonged and for recovery to be less complete. Pallor had never been observed. The patient had congenital club feet. In 1922 both fifth toes had been amputated because of the presence of hammer toe. For the last 4 months she had noticed small blisters on the distal portions of the toes which had healed and broken down from time to time. The subjective symptoms consisted of tingling dull aching in the feet during the periods of cold weather and relief in the summer months. There was cyanosis of the hands with chilling. Thyroidectomy was done on her first visit because of multiple adenomata. It was felt best to have this done before operation on the sympathetics was carried out. Recovery from the thyroidectomy was uneventful and no obvious change was noted in the condition of the extremities. The patient returned August 28 1928 and bilateral lumbar ganglionectomy was performed October 1928. The postoperative results were rather striking. The usual vasodilation was present and sweating disappeared distally from a line approximately 4 inches below the knee (Table I). The vessels of the feet became excessively enlarged and pulsations were exaggerated approximating those observed in the normal radial arteries. All color changes and all subjective symptoms disappeared from the feet. The patient was dismissed 3 weeks after operation. Exposure to cold weather without color change or other symptoms indicated a satisfactory result. It is probable that the condition of the hands will show the usual slow progression and that an operation on the dorsal ganglia eventually may become necessary. Table II and Figure 17 show the summarized data on the surface temperature and rate of heat elimination in the preceding cases.

DORSAL GANGLIONECTOMY FOR RAYNAUD'S DISEASE AFFECTING THE HANDS

CASE 5 A woman aged 25 years 3 years before admission to the clinic suffered from blanching of the right index finger during the early winter months. This was relieved in the summer. The following winter the condition became gradually worse both

TABLE II—SUMMARY OF THE CHANGES IN SURFACE TEMPERATURES AND IN THE RATE OF HEAT ELIMINATION IN THE FEET FOLLOWING LUMBAR GANGLIONECTOMY

| Case | M m l | | | k t mp | | | H t l m | | |
|----------------|-------|------|------|--------|------|---|---------|---|---|
| | D | | | C | | | m t f l | | |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | 31 | 35.5 | 4.3 | 0.51 | 0.95 | | | | |
| 2 | 21 | 36.6 | 14.5 | 0.44 | 1.32 | | | | |
| 3 | 3.9 | 36 | 1 | 0.04 | 1.04 | | | | |
| 4 | | 33.2 | 1.0 | 1.21 | 0.60 | | | | |
| 5 | 19.9 | 32.7 | 1.8 | 0.23 | 1.1 | | | | |
| 6 | 15.0 | 33.2 | 18.2 | 0.39 | 1.03 | | | | |
| Average values | | | 12.1 | 0.62 | 1.01 | | | | |

hands were involved with cyanosis to the wrist associated with numbness and dull aching pain. During the year before she was seen by us the disturbance had occurred during warm weather small dry ulcers developed in different finger tips and a similar condition developed in the feet. The patient was of the thin asthenic type the general examination was otherwise negative. On a summer day the hands were swollen cyanotic and full flexion of them was impossible. There was a small dry ulcer on the end of the right index finger with an area of permanent cyanosis involving the distal phalanx. The vessels of the hands and feet were patent although the pulsations seemed reduced in magnitude. July 31 1928 the first and second thoracic sympathetic ganglia and trunk were removed on the right side. The following day the right hand was warm and dry. During the following week marked increasing dryness of the skin was noticed by the patient over the entire right arm axilla and right side of the face. She noted the same changes on the right anterior surface of the chest to the level of the sixth interspace and on the right posterior surface of the chest to the level of the fifth dorsal vertebra. The pilomotor reaction was not elicited over the entire right arm. The morning after the operation the right pupil was contracted enophthalmos was present and the right cheek was slightly warmer than the left. A complete Horner's syndrome was not present as dilation of the pupil could be elicited with cocaine. The preoperative aching distress in the right hand and arm entirely disappeared. Special studies on the temperature changes were carried on 3 weeks after operation (Table III and Fig. 18).

September 11 1928 the first and second dorsal and inferior cervical ganglia were removed on the left side. Forty eight hours after operation the patient complained bitterly of pain in the back from the occiput down to the level of the scapulae. The pain disappeared in a few days. Definite hyperesthesia

TABLE V.—SURFACE TEMPERATURE OF HANDS BEFORE AND AFTER RIGHT AND LEFT DORSAL GANGLIONECTOMY (CASE)

| D t | T m p t D g r C g d | | | | | | | | | | C m m t |
|-------|---------------------|------|-------------|------------|-------|----------|------------|-------|--|--|---|
| | O t d | Room | R i h t h d | | | | L f t h d | | | | |
| | | | cc f i g | Th d f i g | P l m | Sc f i g | Th d f i g | P l m | | | |
| 6-9-6 | | | 36 | | | | | | | | |
| 8- | | | | | | 7 | | | | | |
| 9-3 | | | | 6 | 38 | 7 | 98 | 35 | | | H d d H |
| 7-8 | | | 58 | 6 | 63 | 5 | 46 | 87 | | | Sw H |
| 8 | | | | 5 | 6 | 3 | 4 | 49 | | | |
| 8 | | | | | | | | | | | R g h t d i f t d l g g l e c t m y |
| 5-3 | | 35 | 3 | 35 | 335 | 35 | 333 | 35 | | | B t h h d w m d r y d f m l l |
| 6-3 | 3 | | | 35 | | 95 | 3 | 35 | | | |
| 3 | 3 | 4 | 3 | 39 | 4 | 5 | 35 | 3 | | | |
| 7-8 | | 3 | 97 | 8 | 3 | 3 | 57 | 3 | | | R i g h t h d l g h l y l t h l f f t p o s t l d |

the left side. The skin of the left cheek was somewhat warmer than that of the right. It was observed that following exposure to cold the vasomotor reactions were much more active in the right than in the left hand. Subsequent letters from the patient have indicated that the condition has remained practically the same. Permanent changes in the blood supply of the hand or abolition of the vasoconstrictor attacks were not accomplished.

CASE 8. A young Russian girl aged 3 years a bookkeeper entered the clinic July 1906. In 1909 the patient had had a mild attack of influenza following which she had noted coldness numbness and bluish discoloration in both hands from the second phalangeal joints. The only excitant had been cold. The condition gradually had become worse. For the 2 years preceding admission to the clinic during winter months pain limited to the second and third fingers had developed with exposure to cold. Three years before she was seen by us blisters had developed on the tip of the four fingers. These all had broken down and had healed. The condition had progressed to the time of admission so as to constitute complete disability. A similar condition but milder was present in the feet. On examination the arteries of the hands were found to be open. Marked cyanosis was present under usual room temperatures when exposed to increased environmental heat the hands became hot red and moist and there was burning pain. The diagnosis was vasospastic neurosis or Raynaud's disease involving the hands and feet. August 3 1906 radical amputation according to the technique of Royle was carried out. The brachial roots were exposed and all the ramified. Twenty-four hours after operation the patient was in good condition. Both hands were warm and no perceptible difference was noted between the two. The following day the right hand was a little more pale than the left but there was no difference in

surface temperature. The pupils were equal. Horner's syndrome was not present. Convalescence was uneventful. Studies carried out weeks later showed no demonstrable difference in the surface temperature or in the rate of heat elimination in the two hands. Exposure to the cold air produced color changes possibly not of so severe a grade as before operation. This patient was seen in 1908 in Florida and it was evident that no improvement had been obtained by this operation.

SUMMARY

In five cases of vasomotor neurosis of the spastic type with symptoms (Raynaud's disease) there was marked and maintained vasodilation in the feet for periods as long as 3 years following operation. Vasomotor activity as measured by the surface temperature was absent or markedly diminished with complete relief from the signs and symptoms of this disease.

Cervical sympathetic ganglionectomy by the anterior approach carried out in two cases of Raynaud's disease of the hands was unsuccessful in producing vasodilation or in ameliorating the signs or symptoms.

Intrathoracic sympathetic ganglionectomy by the dorsal approach was successful in two cases of Raynaud's disease affecting the hands producing dilating effects on the arteries of the hands comparable to that observed in the feet following the lumbar operation.

The striking maintained and unequivocal therapeutic effects of lumbar and dorsal

sympathetic ganglionectomy in Raynaud's disease seem to warrant the belief that surgical control in this disease is an accomplished fact

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DEVELOPMENTAL ABNORMALITIES AT THE LUMBOSACRAL JUNCTURE CAUSING PAIN AND DISABILITY

A REPORT OF ONE HUNDRED AND FORTY SEVEN PATIENTS TREATED BY THE SPINE FUSION OPERATION

RUSSELL A HIBBS MD FACS NEW YORK

AND

WALKER E SWIFT MD NEW YORK

FLUETH NEW YORK HOSPITAL NEW YORK

AT the New York Orthopaedic Dispensary and Hospital in the period from October 1914 to January 1917 147 patients had a lumbosacral fusion operation for the relief of low back pain and disability which was thought to be due to some purely mechanical defect at the lumbosacral juncture the result of an anatomical variation. The time elapsed since these operations has been from 2 to 13 years an average of 4 years which is sufficient to allow a fair estimate of the results and a report is therefore being made of all of them. Three of the patients had to have a second operation before January 1 1927 because of a pseudarthrosis and so this report covers a total of 150 operations.

The lumbosacral juncture is believed to be the part of the spine most vulnerable to mechanical stress and strain for two main reasons first because it is the place where the weight and movements of the trunk are transmitted from the mobile spine to the fixed base the sacrum and second because it has become clear that in this area there are very frequent abnormalities of bone and joint structure any one of which may form a lumbosacral mechanism less fitted than the so called normal to perform its required functions. This does not mean that all individuals with some abnormality of the lumbosacral area have symptoms from it but it does mean that if an individual has symptoms referable to the low back and is found to have in the lumbosacral region an anatomical variation the latter may well be held responsible for the symptoms until proved innocent. The question of low back symptoms arising from a sacro iliac joint cannot be considered in this report except to say that in all these patients no evidence of sacro iliac pathology was recognized.

The 147 patients are divided into five groups according to the anatomical variations found and each group will be analyzed separately. They are as follows:

I Patients who had one or more of these conditions (a) an abnormally acute angle between the fifth lumbar and first sacral body (b) irregularly placed or asymmetrical lateral articulations of the fifth lumbar and first sacral vertebrae (c) impinging spinous processes of the lower lumbar and sacral vertebrae (d) defects in closure of the posterior arch of the first sacral vertebra (e) incomplete bony union between the first and second sacral segments.

II Patients who showed changes in the last presacral vertebra such that it approached in type a sacral vertebra but without complete bony union to the sacrum and evidenced also by an enlarged transverse process articulating with the lateral mass of the sacrum on one or both sides. This condition is called incomplete sacralization of the fifth lumbar vertebra.

III Patients who had a spondylolisthesis or a slipping forward of the body of the fifth lumbar on the sacrum because of failure of union of the arch of the fifth to its body.

IV Patients who had been included in Group I but who were found at operation to have ununited or badly united fractures of a lamina or articular process.

V Patients who had a posterior displacement of the fifth lumbar vertebra on the first sacral.

Before proceeding to an analysis of each group there are certain things to be said about the entire series.

The first operation was done October 13 1914 on a girl aged 13 who had spondylolisthesis.

There were 75 males and 72 females and the ages of the patients at time of operation varied from 10 to 54 years according to the following table

| Y | M | F | T | P | g |
|----------|----|----|-----|-----|---|
| 1 to 10 | 0 | 1 | 1 | 0 | 7 |
| 11 to 20 | 7 | 13 | 0 | 13 | 6 |
| 21 to 30 | 5 | 29 | 54 | 36 | 7 |
| 31 to 40 | 4 | 20 | 44 | 20 | 9 |
| 41 to 50 | 18 | 8 | 26 | 17 | 7 |
| 51 to 60 | 1 | 1 | 2 | 1 | 4 |
| | 75 | 72 | 147 | 100 | 0 |

It will be seen that the largest group 36.7 per cent was between 21 and 30 years old and that 66.6 per cent of the patients were between 21 and 40 at the time of the operation. The average age of the series was 30.7 years when the operation was done but this does not necessarily represent the age at which the symptoms began. It may be said however that the symptoms rarely begin until ossification is complete at which time the capacity for accommodation to mechanical strain is lost to a large degree and that they increase with advancing age.

In each case the diagnosis was arrived at after a study of the history, physical examination and X rays the latter probably being the most important factor. Our understanding of the mechanism of the lumbosacral juncture and its anatomical variations has been much enhanced by the very careful work of von Laskum¹ based on a large number of anatomical dissections. The knowledge thus gained has been of great value clinically and especially so as steadily improved X ray technique has made it possible actually to visualize the lumbosacral juncture. It is now considered necessary to have stereoscopic anteroposterior views of the fifth lumbar and sacrum, clear lateral views with the patient lying and standing and an anteroposterior view taken from below at an angle of 45 degrees. This latter brings out more clearly the sacroiliac joints and also the fifth lumbar and sacral relationships.

There was no operative death in this series of 150 operations and no instance of postoperative shock. One patient has died

but his death was not associated with the operation, it having been due to a carcinoma of the rectum and occurring 8 months later.

The operation in each instance was done according to the Hibbs technique with very great care in doing a subperiosteal dissection in removing all the ligamenta flava, and in curetting the lateral articulations. No bone graft or osteoperiosteal graft was used because the large laminae of the lumbar vertebrae and the wide surface of the sacrum afforded plenty of bone for the necessary fusion. Although the exposure is sometimes difficult on account of the depth of the wound in some individuals there is no reason for not obtaining a perfectly satisfactory fusion provided sufficient care and attention to detail are exercised. The operation is now made easier by the use of a table on which the patient may be placed with the thighs flexed at right angles thereby reducing the lumbar lordosis.

The duration of each operation was as a rule between an hour and an hour and a half. They were done by one of the four attending surgeons.

The postoperative treatment consisted of a period of recumbency in bed for 6 to 8 weeks during which time a light steel lumbosacral brace was applied. The length of time this brace was worn after the patient was ambulatory varied between 3 months and a year and depended greatly on the type of patient. The tendency has been to shorten the period during which support is used.

It has not seemed worth while to try to draw any conclusion as to the average length of time before the patients returned to their full activities as this period again varied so greatly with each one and depended so much on the individual's economic status and the character of his work. Patients were expected to be able to undertake anything except heavy work by the end of 4 months and any restriction as to activities was removed by the end of 8 months. The experience of having had an injury to or an operation on the spine seems to create in many persons a psychological sense of apprehension and carefulness which it is hard for them to overcome and which the surgeon must treat intelligently if he wishes to shorten their convalescence.

Eight patients in this series in whom it was suspected that fusion was not complete because of the persistence of severe symptoms at the end of 7 or 8 months have had exploratory operations at which a pseudarthrosis was found and repaired. Only three of these second operations are included in the report as the other five have been done since January 19 7¹

An effort has been made to follow each patient at frequent intervals during the first year and after that at least once or twice a year for as many years as possible. As will be indicated a number of persons have been lost for one reason or another before it was possible to be certain of the result but on the whole the follow up seems to have been quite satisfactory.

The results of these operations have been classified as follows (1) patients who have complete relief from their previous symptoms (2) patients who are improved but still have a few symptoms (3) patients who are unimproved.

A detailed analysis of each of the five main groups of patients will now be given.

GROUP I

This group consists of the persons who were found to have one or more of the following abnormalities

1. An acute angle between the fifth lumbar and first sacral vertebrae as determined by lateral X rays. The mechanical situation at the lumbosacral juncture is not adequately expressed by the measurement of any one single angle. In the first place an inclination of the articular surface of the first sacral vertebra of more than 42.5 degrees to the horizontal constitutes a mechanical weakness. In the second place if the center of gravity of the trunk approximately represented by a vertical line drawn through the center of the body of the third lumbar vertebra passes anterior to instead of through the body of the first sacral vertebra a mechanical weakness is present. In this report a case showing one or both of these mechanical weaknesses is classed as an acute lumbosacral angle. For a complete descrip-

tion of these relationships reference is again made to the article by von Lackum from which Figure 1 is reprinted.

Irregularly placed and asymmetrical lateral articulations of the fifth lumbar and first sacral

3. Impinging spinous processes of the lower lumbar and sacral vertebrae.

4. Defects in closure of the posterior arch of the first sacral vertebra.

5. Incomplete bony union between the first and second sacral segments. It is impossible to say in any one instance which of these findings was actually responsible for the symptoms as most of the patients had a combination of two or three of them and so all of these abnormalities are grouped under one heading. Any one of them alone however may be a cause of lumbosacral weakness and pain.

In this group are reported 78 patients and 19 operations as one person had a pseudarthrosis which required a second fusion. There were 35 males and 43 females.

The ages of the patients varied from 13 to 52 years the average being 33.4 years. The youngest patient was a girl who had congenitally dislocated hips. These had been unsuccessfully treated by closed reductions and she developed a severe lumbar lordosis with a very acute lumbosacral angle causing low back pain. She was relieved of the symptoms after the fusion operation. The following table gives the age distribution of this group.

TABLE OF AGES GROUP I

| | M | F | T |
|----------|----|----|----|
| 13 to 14 | | 9 | |
| 15 to 19 | | 9 | 3 |
| 20 to 24 | | 5 | 5 |
| 25 to 29 | | | |
| 30 to 34 | | | |
| 35 to 39 | | | |
| 40 to 44 | | | |
| 45 to 49 | | | |
| 50 to 52 | | | |
| Total | 35 | 43 | 78 |

Symptomatology. The symptoms complained of varied from simply a weak back causing the patient to tire easily to very acute pain in the low back with real disability. There was a very frequent history of having had attacks of pain with an intervening period of comfort lasting several years perhaps but becoming more and more frequent or constant as age advanced. The exact location of the pain has

been hard to determine from the descriptions in the records and from the patients' memories a long time after the operation but it seems clearly to have been referred to the lumbosacral region frequently to radiate and to be relieved by rest or often by a tight pelvic corset. The exact character of the radiation pain has also been hard to determine and no definite nerve root distributions can be given. In some patients the pain seems to have radiated into the buttocks or hips in others into the backs of the thighs in others into the calves of the legs and in others along the entire course of the sciatic nerve on one or both sides.

Duration of symptoms. The duration of symptoms before operation varied a good deal. The longest period was 5 years the shortest was 1 month and the average 6 years.

History of injury. There was a positive history of injury or strain at the onset of symptoms in 41 or 52.5 per cent and a negative history in 37 or 47.5 per cent.

Radiation of pain. A history of radiation of pain was obtained in 38 or 48.7 per cent the radiation being unilateral in 29 and bilateral in 9. There was no radiation in 40 or 51.3 per cent. As said before nothing definite is concluded as to the actual distribution of the radiated pain.

RESULTS OF OPERATIONS GROUP I

| | N | m | b | f | P | t | g |
|---------------------------|----|---|---|---|----|---|---|
| Class 1 Entirely relieved | 5 | 8 | | | 73 | 4 | |
| Class 2 Improved | 10 | | | | 1 | 7 | |
| Class 3 Unimproved | 1 | | | | 13 | 0 | |

Of the patients in Class 1 6 were lost before a year elapsed but they had no symptoms when last seen. They may or may not still be free of symptoms.

Of the patients in Class 2 4 were lost before a year had elapsed. The cause of the persistence of symptoms in this class is not determined. None of them is incapacitated and all those who have been followed say that they are very much better than before the operation.

Of the patients in Class 3 only 1 was lost before a year of follow up. When last seen at 9 months he was having a great deal of pain was thought to have a pseudarthrosis and was advised to have an exploratory operation.

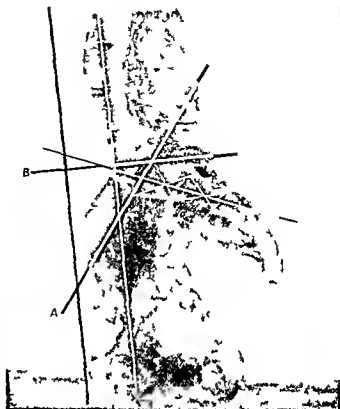


Fig. 1. Method used in determining the mechanical situation at the lumbosacral junction. The angle formed by *A* and *B* represents the inclination of the articular surface of the first sacral vertebra to the horizontal and should not exceed 42.5 degrees. The line *x* indicates whether or not the center of gravity of the trunk passes in front of the body of the first sacral vertebra.

Three patients had second operations and pseudarthrosis repaired one of whom is reported in this series and has apparently failed a second time to fuse as she is still unrelieved. At the second operation it was found that there had been no apparent attempt to regenerate bone anywhere in the fused area, and presumably a similar condition existed after the second fusion. Three patients seem to have a definite arthritis of the lumbar spine and this is thought to be responsible for the continuance of their symptoms. Two patients still have symptoms which are suggestive of sacro iliac pathology and in these an error of diagnosis may have been made. The X rays in these two seem to show good fusion.¹ Another patient has had a recent second operation at which the fusion was found solid but

N th fth p ti tsh ec thyb p r d O m was
f d t h p d thros b h was p r d O m w
f d t h y ll if t b t n xpl ng th p l t
t pp d th tsh was thrt p t d narthrod is fth t
j m w d

several exostoses at its upper margin were clearly impinging against the next lumbar vertebra and it was thought accounted for the pain. She is however still unimproved.

GROUP II

In this group are those patients who were found to have the last lumbar or first sacral vertebra more or less of a sacral type but without firm bony union to the sacrum a so called incomplete sacralization. The most striking instance is that in which the transverse processes are greatly enlarged either unilaterally or bilaterally thus forming an articulation with the lateral mass of the sacrum. Such a condition is thought to be very susceptible to strain and in patients with it a lumbosacral fusion has been done in order to incorporate in the sacrum the vertebra which nature had left partly sacral. This procedure would seem to be more reasonable and is certainly easier to do than the removal of an enlarged transverse process. The latter if accomplished has the definite disadvantage of giving more mobility to a vertebra which is not adapted anatomically for motion.

The group comprised 3 patients and 33 operations as one patient had a second operation for pseudarthrosis.

There were 17 males and 15 females.

The ages varied from 10 to 47 years the average being 30.6 years. The ages were distributed as follows:

TABLE OF AGES GROUP II

| Age | M | F | Total |
|----------|----|---|-------|
| 10 to 20 | | 1 | 3 |
| 21 to 30 | 8 | 4 | 12 |
| 31 to 40 | 5 | 6 | 11 |
| 41 to 50 | | 3 | 3 |
| 51 to 60 | 0 | 0 | 0 |
| | 13 | 5 | 18 |

The youngest patient was a girl who had been under treatment for several years and was suspected of having tuberculosis of a hip joint because of pain referred to that region. X rays of the hip were consistently negative for any evidence of tuberculosis but they did show an incompletely sacralized fifth lumbar vertebra. It was finally decided that this condition was the cause of her persisting symp-

toms and a lumbosacral fusion was done and was followed by complete relief. There have since been several somewhat similar experiences.

Symptomatology The clinical picture varied little if at all in these patients from that described under Group I except that there was a 1 percent higher incidence of radiating pain.

Duration of symptoms The longest period of symptoms before operation was 37 years the patient being a woman who was operated on when she was 47 and who has been entirely relieved. The shortest period was 1 month and the average was 2 years and 9 months.

History of injury A history of injury or strain at onset of symptoms was positive in 18 patients or 56.2 per cent and was negative in 14 patients or 43.8 per cent.

Radiation of pain Radiation of pain was present in 20 patients or 60.6 per cent and was absent in 13 patients or 39.4 per cent. As said before no data as to nerve root distribution of pain can be given but the following facts are of interest regarding the patients who did have radiating pain.

There were 16 patients who had a bilateral incomplete sacralization of the last lumbar vertebra. Ten of these or 65 per cent gave a positive history of radiating pain. Of these 10 6 had radiation in both legs and 4 in only one leg.

There were 17 patients who had a unilateral incomplete sacralization. Ten of these or 58.8 per cent gave a positive history of radiating pain. Of these 10 5 referred the radiating pain to the leg on the side of the sacralization and 5 referred it to the opposite leg. Two of the last 5 have not been entirely relieved of their symptoms.

RESULTS OF OPERATIONS GROUP II

| Class | Entirely relieved | Partially relieved | Not relieved |
|---------|-------------------|--------------------|--------------|
| Class 1 | 4 | 7 | 7 |
| Class 2 | 1 | 1 | 1 |
| Total | 5 | 8 | 8 |

Of the patients in Class 1 5 were lost before a year of observation but were well when last seen.

Of the patients in Class 2 all have been followed well beyond a year and the reason for the persistence of symptoms is not explained.

None of them has severe pain and several seem to be getting better

Of the patients in Class 3 1 was not relieved when last seen 7 months after operation One was relieved of painful symptoms but not of a drug addiction acquired before operation One was re-operated on for a pseudarthrosis with entire relief and he is included also in Class 1

GROUP III

This group consisted of those patients who had 1 spondylolisthesis with a forward displacement of the fifth lumbar to a distance varying from about one quarter inch to the full width of the body of the vertebra the most extreme instance being one in which the body of the fifth lumbar was lying actually in front of and at practically the same level as the first sacral There was found uniformly to be a separation of the laminae of the fifth lumbar from its pedicles at a point dorsal to the superior articular facets so that there was no bony anchorage to prevent the body of the fifth lumbar with the superimposed spine from slipping forward This is believed to be a congenital defect and it seems obvious that an operation which will produce strong bone fusion between the fourth or third lumbar vertebra and the sacrum is the logical procedure to employ in order to give stability to such a spine

There are reported in this group 23 patients and 24 operations one patient having had a pseudarthrosis repaired There are 15 males and 8 females

The ages varied from 13 to 51 years the average being 28.9 years which is noticeably lower than the age of the other groups The patients were distributed in these age periods

TABLE OF AGES GROUP III

| Y | Mal | F m l | T t l |
|----------|-----|-------|-------|
| 1 to 10 | 0 | 0 | 0 |
| 11 to 20 | 3 | | 5 |
| 21 to 30 | 5 | 4 | 9 |
| 31 to 40 | 5 | 1 | 6 |
| 41 to 50 | 2 | 0 | 2 |
| 51 to 60 | 0 | 1 | 1 |
| | 15 | 8 | 23 |

The youngest patient a girl aged 13 years had had symptoms for several years and a lumbosacral region thought at first to be due to tuberculosis of the spine

The oldest patient was a nurse aged 51 years who had had no symptoms until the age of 41 years when she had an attack of severe pain after lifting a patient This was relieved in a few months and she had no further trouble for 9 years Then she had a recurrent attack of severe pain and for a year before the operation her disability and pain were steadily increasing Both of these patients have had complete relief

Symptomatology The clinical picture did not differ in any special respect from that of the other groups except that the physical examination usually revealed the typical severe lumbar lordosis and prominent spinous process of the fifth lumbar and sacrum The X ray examination of course gave the diagnosis

Duration of symptoms The longest period was 20 years the shortest 1½ months the average being 1 year and 10 months

History of injury There were 11 patients 47.8 per cent who gave a positive history of injury or strain before the onset of the symptoms and 12 or 52.2 per cent who had no injury It is very interesting that injury was a factor in a definitely smaller percentage of patients than in any of the other groups

Radiation of pain A positive history of radiating pain was given by 15 patients or 65.2 per cent and a negative one by 9 or 37.5 per cent Of the 15 patients who had a history of radiating pain there were 8 or 53.3 per cent who had it in only one leg and 7 who referred it to both legs The region to which the pain was referred varied between the buttocks the hips the thighs and the legs No exact distribution can be given

RESULTS OF OPERATIONS GROUP III

| | N mb of | P t g |
|---------------------------|---------|-------|
| | P t | P t g |
| Class 1 Entirely relieved | 16 | 66.9 |
| Class 2 Improved | 3 | 12.5 |
| Class 3 Unimproved | 5 | 20.8 |

Of the patients in Class 1, all but one have been followed for periods ranging from 1½ to 14 years That one was free of symptoms when last seen 8 months after operation

Of the patients in Class 2 all have been followed more than 1½ years None is complaining of severe pain and they seem to be steadily improving

Of the patients in Class 3 one woman has been advised to have an exploratory operation as a pseudarthrosis is suspected. Two men have been re-operated on successfully for a pseudarthrosis one of these second operations being included in this report under Class 1. One woman has been re-operated on at another hospital. One patient a man aged 4 years at the time of operation died 8 months after the operation with a diagnosis of carcinoma of the rectum. Whether or not this condition was responsible for his pre-operative symptoms cannot be determined. He gave no history of injury nor of radiating pain before operation but he did have lumbar muscle spasm and pain on bending the spine and he was completely disabled. He complained of bowel symptoms for the first time about 3 months after the operation.

The higher incidence of pseudarthrosis in this group is explained by the pathology which makes the operation a good deal more difficult than usual and necessitates most meticulous care in the dissection and transposition of bone. It is believed that even in these cases a bone graft is unnecessary.

GROUP IV

In this group are included patients who had definite anatomical variations at the lumbosacral region but who were found at the time of operation to have also ununited or badly united fractures of a lamina or articular process. Which condition actually caused the symptoms is not determined.

There are reported in this group 8 operations on 8 patients, 4 males and 4 females.

The ages varied between the youngest who was 23 and the oldest who was 50. The average age was 37.0 which is noticeably older than any of the other groups. The following table shows the age distribution.

TABLE OF AGES GROUP IV

| | Male | Female | Total |
|----------|------|--------|-------|
| 1 to 10 | 0 | 0 | 0 |
| 11 to 20 | 0 | 0 | 0 |
| 21 to 30 | 0 | 0 | 0 |
| 31 to 40 | 0 | 3 | 3 |
| 41 to 50 | 0 | 0 | 0 |
| 51 to 60 | 0 | 0 | 0 |
| | 4 | 4 | 8 |

Symptomatology The clinical picture was essentially similar to that of the other group except if anything the symptoms were severe. It is interesting to note that the roentgenograms did not show any fractures and it is believed that the presence of many fractures of the posterior elements of the spine can be determined only by exploratory operation.

Duration of symptoms The longest period of symptoms was 14 years the shortest period was 6 months and the average period was 5 years 11 months.

History of injury An injury had been associated with the onset of symptoms in all of the patients.

Radiation of pain A history of radiating pain was positive in 5 or 62.5 per cent and was negative in 3 or 37.5 per cent. Of the 5 patients with radiating pain referred it to both legs and 3 to one leg.

RESULTS OF OPERATIONS GROUP IV

| | Number of patients | Percentage |
|------------------------|--------------------|------------|
| Class 1 Ectopic lesion | 6 | 75.0 |
| Class 2 Impacted | 2 | 50.0 |
| Class 3 Unimpacted | 0 | 0.0 |

Of the patients in Class 1 all have been followed for periods of 1½ to 7 years except one man who was at work and free of symptoms when last seen 7 months after operation.

One patient in Class 2 was lost 9 months after operation but he had only a slight amount of pain and seemed to be steadily improving. The other has had several temporary attacks of severe pain in the back but is very much better than before the fusion and is able to carry on a very active life.

GROUP V

In this group were patients in whom a diagnosis was made of a posterior displacement of the fifth lumbar on the first sacral. This condition is very definite and occurs when the lateral articulations between the fifth lumbar and the sacrum are quite long and of the anteroposterior type as in the thoracic region thus allowing an unusual degree of anteroposterior mobility between the fifth lumbar and sacrum. The displacement is not necessarily permanent but seems to represent a subluxation of the lateral articulations with

ANALYSIS OF ONE HUNDRED FORTY-SEVEN CASES

| G p | N f
p t | N f
op t | A g
y | A d t
f ym
t m
yr m | H t y
I y t | R d t
P f t | P t h
P t t | A l g
f l w
yr m | E t r
P l t | Imp
P t | U m
P c t |
|-----------------------------------|------------|-------------|----------|------------------------------|----------------|----------------|----------------|------------------------|----------------|------------|--------------|
| I—A t l mb cr l
gl | 78 | 79 | 33 4 | 6 | 5 5 | 48 7 | 6 3 | 3-0 | 73 4 | 7 | 3 9 |
| II—S ^{1/2} t
5th l mb | 3 | 33 | 3 6 | 9 | 56 | 6 6 | 3 | 3 7 | 7 7 | 8 | 9 |
| III—Sp dyl f th | 3 | 4 | 5 9 | | 47 8 | 6 5 | 8 3 | 4 | 66 7 | 5 | 8 |
| IV—F t f l m x | 8 | 8 | 37 6 | 5 | | 6 5 | | 4 6 | 75 | 5 | |
| V—P t d pl
m nt 5th l mb | 6 | 6 | 33 | 4 | 83 3 | 5 | | 4 6 | | | |
| T t l | 47 | 5 | 3 7 | 4 3 | 68 | 54 | 5 3 | 4 | 73 3 | 4 | 7 |

the possibility of a reduction taking place at any time. In one patient this seemed to occur during the operation when there was found to be no motion between the fifth lumbar vertebra and first sacral until while the ligaments were being curetted something snapped and then there was the usual degree of motion present. The pre operative lateral roentgenograms of this patient were interpreted as showing a posterior displacement but the post operative lateral X rays did not. There are reported in this group 6 patients and 6 operations and there were 4 males and 2 females.

The ages of the patients varied from 17 years to 47 years the average age being 33.

TABLE OF AGES GROUP V

| X | M l | F m l | T t l |
|----------|-----|-------|-------|
| 1 to 10 | 0 | 0 | 0 |
| 11 to 20 | 0 | 0 | 1 |
| 21 to 30 | 0 | 1 | 1 |
| 31 to 40 | 2 | 0 | 2 |
| 41 to 50 | 2 | 0 | 2 |
| | 4 | — | 6 |

Symptomatology No unusual clinical findings were noted as diagnostic or characteristic but the X rays revealed the pathology.

Duration of symptoms The longest period of symptoms was 20 years the shortest period was 6 months and the average period was 4 years 11 months.

History of injury A history of injury or strain associated with the onset of symptoms was given by 5 patients 83.3 per cent but was negative in 1.

Radiation of pain Radiating pain was present in 3 or 50 per cent 2 patients referring it to one leg and 1 patient referring the pain to both legs. Three had no radiating pain.

RESULTS OF OPERATION GROUP V

| | N mb
p t | f | P t g |
|---------------------------|-------------|-----|-------|
| Class 1 Entirely relieved | 6 | 100 | 0 |
| Class 2 Improved | 0 | 0 | 0 |
| Class 3 Unimproved | 0 | 0 | 0 |

One patient was lost at the end of 6 months but was free of symptoms at that time. The others have been followed from 2 to 8 years.

A study of the accompanying table will show the main facts in the analysis of these 147 patients and will reveal the interesting relationships between the separate groups.

SUMMARY

1 One hundred and fifty lumbosacral fusion operations are reported which were done on 147 patients who had low back symptoms which were thought to be due to some purely mechanical defect of the lumbosacral juncture.

2 The operations were all done before January 1, 1927.

3 The first operation was done October 13, 1914.

4 There were 75 males and 72 females in the series.

5 The age at time of operation varied between 10 and 50 the average being 30.7 years. 36.7 per cent of the patients were between the ages of 21 and 30 and 29.9 per cent were between 31 and 40.

Of the patients in Class 3 one woman has been advised to have an exploratory operation as a pseudarthrosis is suspected. Two men have been re-operated on successfully for a pseudarthrosis one of these second operations being included in this report under Class 1. One woman has been re-operated on at another hospital. One patient a man aged 42 years at the time of operation died 8 months after the operation with a diagnosis of carcinoma of the rectum. Whether or not this condition was responsible for his pre-operative symptoms cannot be determined. He gave no history of injury nor of radiating pain before operation but he did have lumbar muscle spasm and pain on bending the spine and he was completely disabled. He complained of bowel symptoms for the first time about 3 months after the operation.

The higher incidence of pseudarthrosis in this group is explained by the pathology which makes the operation a good deal more difficult than usual and necessitates most meticulous care in the dissection and transposition of bone. It is believed that even in these cases a bone graft is unnecessary.

GROUP IV

In this group are included patients who had lumbosacral anatomical variations at the lumbosacral region but who were found at the time of operation to have also ununited or badly united fractures of a lamina or articular process. Which condition actually caused the symptom is not determined.

There are reported in this group 8 operations on 8 patients 4 males and 4 females.

The ages varied between the youngest who was 3 and the oldest who was 50. The average age was 7.6 which is noticeably older than any of the other groups. The following table shows the age distribution.

TABLE OF AGES GROUP IV

| Age | Males | Females | Total |
|-------|-------|---------|-------|
| 3 | | 0 | 0 |
| 4 | | 0 | 0 |
| 5 | | 0 | 0 |
| 6 | | 0 | 0 |
| 7 | 3 | 0 | 3 |
| 8 | 1 | 0 | 1 |
| 9 | 0 | 1 | 1 |
| 10 | 0 | 1 | 1 |
| 11 | 0 | 1 | 1 |
| 12 | 0 | 1 | 1 |
| 13 | 0 | 1 | 1 |
| 14 | 0 | 1 | 1 |
| 15 | 0 | 1 | 1 |
| 16 | 0 | 1 | 1 |
| 17 | 0 | 1 | 1 |
| 18 | 0 | 1 | 1 |
| 19 | 0 | 1 | 1 |
| 20 | 0 | 1 | 1 |
| 21 | 0 | 1 | 1 |
| 22 | 0 | 1 | 1 |
| 23 | 0 | 1 | 1 |
| 24 | 0 | 1 | 1 |
| 25 | 0 | 1 | 1 |
| 26 | 0 | 1 | 1 |
| 27 | 0 | 1 | 1 |
| 28 | 0 | 1 | 1 |
| 29 | 0 | 1 | 1 |
| 30 | 0 | 1 | 1 |
| 31 | 0 | 1 | 1 |
| 32 | 0 | 1 | 1 |
| 33 | 0 | 1 | 1 |
| 34 | 0 | 1 | 1 |
| 35 | 0 | 1 | 1 |
| 36 | 0 | 1 | 1 |
| 37 | 0 | 1 | 1 |
| 38 | 0 | 1 | 1 |
| 39 | 0 | 1 | 1 |
| 40 | 0 | 1 | 1 |
| 41 | 0 | 1 | 1 |
| 42 | 0 | 1 | 1 |
| 43 | 0 | 1 | 1 |
| 44 | 0 | 1 | 1 |
| 45 | 0 | 1 | 1 |
| 46 | 0 | 1 | 1 |
| 47 | 0 | 1 | 1 |
| 48 | 0 | 1 | 1 |
| 49 | 0 | 1 | 1 |
| 50 | 0 | 1 | 1 |
| Total | 4 | 4 | 8 |

Symptomatology. The clinical picture was essentially similar to that of the other groups except if anything the symptoms were more severe. It is interesting to note that the roentgenograms did not show any fractures and it is believed that the presence of many fractures of the posterior elements of the spine can be determined only by exploratory operation.

Duration of symptoms. The longest period of symptoms was 14 years the shortest period was 6 months and the average period was 5 years 11 months.

History of injury. An injury had been associated with the onset of symptoms in all of the patients.

Radiation of pain. A history of radiating pain was positive in 5 or 65 per cent and was negative in 3 or 37.5 per cent. Of the 5 patients with radiating pain 2 referred it to both legs and 3 to one leg.

RESULTS OF OPERATIONS GROUP IV

| Class | Entirely relieved | Improved | Unimproved |
|---------|-------------------|----------|------------|
| Class 1 | 6 | 75 | 5 |
| Class 3 | 0 | 0 | 0 |

Of the patients in Class 1 all have been followed for periods of 1 1/2 to 7 years except one man who was at work and free of symptoms when last seen 7 months after operation.

One patient in Class 3 was lost 9 months after operation but he had only a slight amount of pain and seemed to be steadily improving. The other has had several temporary attacks of severe pain in the back but is very much better than before the fusion and is able to carry on a very active life.

GROUP V

In this group were patients in whom a diagnosis was made of a posterior displacement of the fifth lumbar on the first sacral. This condition is very definite and occurs when the lateral articulations between the fifth lumbar and the sacrum are quite long and of the anteroposterior type as in the thoracic region thus allowing an unusual degree of anteroposterior mobility between the fifth lumbar and sacrum. The displacement is not necessarily permanent but seems to represent a subluxation of the lateral articulations with

ANALYSIS OF ONE HUNDRED FORTY-SEVEN CASES

| G p | N f
p t | N f
p t | A g
y | A d t g
f y m p
yr m | Hist ry
f y t | R d t
f p t | P d
t | A f l g
f l w p
yr mos | E l f
p t | Imp
p t | U m d
p t |
|-------------------------|------------|------------|----------|----------------------------|------------------|----------------|----------|------------------------------|--------------|------------|--------------|
| I—A t l mbo
gl | 78 | 79 | 33 4 | 6 | 5 5 | 45 7 | 6 3 | 3 9 | 73 4 | 7 | 3 9 |
| II—S al t
sth l mb | 3 | 33 | 3 6 | —0 | 56 | 6 6 | 3 | 3 7 | 7 7 | 8 | 9 |
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m th l mb | 6 | 6 | 33 | 4 | 83 3 | 5 | | 4-6 | | | |
| T t l | 47 | 5 | 3 7 | 4 3 | 63 | 54 | 5 3 | 4 | 73 3 | 4 | 7 |

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|----------|-----|-------|-------|
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| 11 to 20 | 0 | 1 | 1 |
| 21 to 30 | 0 | 1 | 1 |
| 31 to 40 | 2 | 0 | 2 |
| 41 to 50 | — | 0 | — |
| | 4 | 2 | 6 |

Symptomatology No unusual clinical findings were noted as diagnostic or characteristic but the X rays revealed the pathology.

Duration of symptoms The longest period of symptoms was 20 years the shortest period was 6 months and the average period was 4 years 11 months.

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Radiation of pain Radiating pain was present in 3 or 50 per cent of patients referring it to one leg and 1 patient referring the pain to both legs. Three had no radiating pain.

RESULTS OF OPERATION GROUP V

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p t | f | P t g |
|---------------------------|-------------|-----|-------|
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SUMMARY

1 One hundred and fifty lumbosacral fusion operations are reported which were done on 147 patients who had low back symptoms which were thought to be due to some purely mechanical defect of the lumbosacral juncture.

The operations were all done before January 1, 1927.

3 The first operation was done October 13, 1914.

4 There were 75 males and 7 females in the series.

5 The age at time of operation varied between 10 and 52 the average being 30.7 years. 36.7 per cent of the patients were between the ages of 1 and 30 and 79.9 per cent were between 31 and 40.

6 There was no operative death in the series

7 Very strong bony fusion of the fifth lumbar to the sacrum is accomplished by the operation

8 There were 8 or 5.3 per cent unsuccessful operations due to a failure of fusion or pseudarthrosis and these have been reoperated on

9 The average history of symptoms before operation covered a period of 4 years 3 months

10 There was radiation of pain into some part of the leg on one or both sides as a preoperative symptom in 81 or 54.0 per cent of the patients

11 The results of the entire series of 150 operations are as follows 110 patients 73.3 per cent are entirely relieved 1 patient 14.0 per cent are improved 19 patients 12.7 per cent are unimproved

12 Some anatomical or mechanical variation of the lumbosacral region is thought to be the underlying cause of the symptoms which are present in many patients who are suffering with low back pain

In such patients a lumbosacral fusion is considered to be the method of treatment best calculated to give permanent relief and to be fully justified by the results obtained in this series

THE BLOOD SUPPLY OF THE THYROID GLAND WITH SPECIAL REFERENCE TO THE VASCULAR SYSTEM OF THE CRETIN GOITER

OWEN H. WANGENSTEEN, M.D. MINNEAPOLIS, MINNESOTA
Fifth Surgical Clinic of First and Quincy Avenues, St. Louis

ONE of the important phases of the goiter problem in Switzerland is that presented by endemic cretinism. In the Canton of Berne alone five institutions with approximately 700 cretin inmates are devoted to the care of these unfortunate individuals. The interest and considerable study accorded this problem by the Surgical Clinic at Berne is therefore at once understandable.

Endemic cretinism occurs only where goiter is endemic. In only a few of the numerous regions where goiter is prevalent, however, does endemic cretinism exist. In mountainous areas where the goiter endemic is especially intense, endemic cretinism is most likely to make its appearance. Professor de Quervain (28) informs me that among others five such endemic cretin districts are especially well known: viz. (1) Cantons Aargau, Fribourg, and Valais in the Swiss Alps; (2) mountainous districts in the Austrian Alps; (3) sections of the Himalayan Mountains; (4) mountainous areas in South America; (5) sections of the American Rocky Mountains.

In an institution devoted to the care of cretins every gradation of the disease may be seen, variations from idiotic individuals with a status inferior to that of an animal to those who manifest only slight abnormalities, may be observed. In the severe form of the disease, idiocy, deaf mutism, retardation of skeletal growth, and myxedematous changes in the skin are generally present. In such instances an atrophy of the thyroid gland early in life has usually occurred. In the lighter forms of endemic cretinism, and especially in those instances in which the retardation of skeletal growth is not so marked, such individuals as Professor de Quervain (30) has pointed out, frequently are cretins with goiter (Fig. 15). Marked mental retardation with speech disturbances or deaf mutism, however, are also common in such cretins. It is to be presumed

that in cretins with goiter in whom the disease makes its appearance later than in the usually more severe groups of cretins without goiter, the thyroid function for at least the first few years of life was quite sufficient.

Not infrequently even individuals with the most intense manifestations of the disease fail to exhibit the myxedematous changes in the skin seen in patients suffering from myxedema. The uniformly marked reduction of the basal metabolism observed in sporadic cretins or patients with myxedema. Professor de Quervain and Pedotti (37) did not find in corresponding degree in endemic cretins. They found average values of minus 8 to 11 per cent in cretins with and without goiter.

Undoubtedly, however, the most striking feature of endemic cretinism is hypothyroidism. When endemic cretinism manifests itself in many more gradations than the more uniform picture of myxedema, it should be remembered as both Professors de Quervain (30) and Wegelin (40) have pointed out, that the function of the thyroid in the endemic cretin during different periods of development may not always be the same. The appearance of preponderant disturbances in one or other system of organs, e.g., retardation of skeletal growth in endemic cretinism depends in large measure on the time of the manifestation of the thyroid inadequacy in relation to the time period in which the growth and development of various structures obtains.

THE THYROID OF ENDEMIC CRETINS

Wydler performed biopsy of the thyroid tissue in a few patients with severe cretinism at the Surgical Clinic of Berne in whom no thyroid was to be felt overlying the trachea. Invariably atrophic tissue scarcely recognizable microscopically as thyroid gland was found. Microscopically degenerative changes of high degree were constantly in evidence.

The thyroid of the cretin with goiter is almost uniformly an adenomatous one. Rarely is a diffuse goiter present in such an individual. Occasionally also the thyroid may partake of a colloid nature. The formation of nodules in the cretin goiter apparently occurs early. In the cretin goiter of a girl of 7 years studied in this series the adenomatous character of the removed goitrous tissue was already quite obvious (Fig. 1). Wylder (43) has compared a series of non cretin goiters removed at the surgical clinic at Berne with another from an individual with endemic cretinism. The incidence of degenerative change in the cretin goiter he found much greater than for the non cretin goiter. Especially are degenerative changes more frequent in the extra adenomatous tissue of the cretin goiter than in that of the non cretin. In the latter the degenerative change are confined largely to the areas about the adenomata while the remainder of the extra adenomatous tissue may appear fairly normal. In the cretin goiter on the contrary the non adenomatous tissue may be quite uniformly involved in an atrophic process in which all type of nuclear degenerative change may be seen. That the cretin goiter has no pathognomonic histological picture must however be frankly admitted. The presence of regenerative areas within the adenomata of cretin goiters is not unusual.

It should be pointed out here that Imille Woelz observed degenerative changes (fibrosis, calcification and cyst formation) present more frequently in goiters removed at Basle during Prof. de Quervain's activity there than in goiters removed at the Surgical Clinic at Berne. Basle lies rather toward the periphery of the goiter endemic and is relatively free from endemic cretinism. This greater incidence of degenerative changes in the adenomata of the non cretin district at Basle probably find its explanation as Woelz suggests in the fact that colloid adenomatous nodules are more prone to exhibit degenerative phenomena than the microfollicular parenchymatous adenomatous goiter. The latter is the type of goiter usually observed at Berne whereas the thyroid from the non goitrous plain of northern Germany as Isenschmid has pointed out have larger follicles with a

greater amount of colloid. The influence of the intermediate position of Basle in the goiter endemic is also manifested in its goiters such that the thyroid follicles usually partake more of the macrofollicular type.

In performing partial thyroidectomy on cretins with goiter it has been frequently noted in the surgical clinic at Berne that the extraglandular vessel are often very large. Professor de Quervain (30) refers to instances in which the thyroid arteries attained the unusual diameter of 10 millimeters and reports the instance of a boy in whom the inferior thyroid artery was larger than the usual carotid at that age. In his monograph on the histology of the cretin goiter Wylder states that in almost half of the cretins operated upon in his series the extraglandular vessels were of unusual size. He has described instances in which the inferior thyroid artery has attained the extraordinary size of the usual carotid or axillary artery.

This study carried out at the suggestion and under the direction of Professor de Quervain is concerned largely with the intraglandular vessels of cretin goiters. The necessity of an investigation of the finer blood supply of goiters of cretins is evidenced by the fact that many confused conceptions prevail concerning the vascularization of such gland as well as concerning the nature of the cretin goiter in general. Though the investigation of the blood supply of cretin goiters has not proceeded further than the observation of the frequent presence of large vessels to the gland a number of suggestions have been made to account for this phenomenon. Merke has suggested that a diminished permeability of the blood capillaries may not permit an adequate vascularization of the thyroid gland in cretins. Breitner believes that the atrophic epithelium of the cretin goiter is unable to utilize its blood supply. Even when the production of secretion is assured through a liberal supply of blood Breitner states that this vascularization is of no avail in cretin thyroid because the second important component of function the removal of secretion is inhibited by the accumulation of colloid in the gland.

The rarity with which the cretin goiter partakes of a colloid nature has already been

pointed out and when Breitner refers to an inhibition or removal of secretion due to the accumulation of colloid it is apparent that he is speaking of an unusual type of cretin goiter.

A study of the intraglandular vessels of a fairly large number of ordinary adenomatous goiters and a few normal thyroids has also been made in order to establish a basis for comparison. Before presenting the results of this study what is known concerning the vascularization of the normal thyroid and other forms of goiter will be briefly reviewed.

THE BLOOD SUPPLY OF THE NORMAL THYROID GLAND

The rich blood supply of the normal thyroid gland is well known. This small gland which receives the almost undivided flow of blood from its four arteries as well as from anastomotic vessels enjoys the provision of a multiple and liberal source of arterial supply not accorded any other organ of its size in the body. Tschueswsky calculated in the dog that the entire volume of blood coursed through the thyroid gland sixteen times a day. When the minute flow through the thyroid is compared with that established by Landergren and Tigerstedt for the brain and kidney in the dog, Tschueswsky estimated the blood supply of the thyroid to be twenty-eight times greater than that for the brain and 5.6 times more than that for a kidney.

A large number of investigations on the arterial circulation of the thyroid are to be found in the literature. How many of such studies were made on pathological material is however not always apparent.

Arteries. In his monograph on the diseases of the thyroid gland von Eiselsberg stated that the inferior thyroid artery is the most important vessel of the thyroid. Latarjet and Alamartine concluded from their study of forty-five thyroids that the superior is the more important vessel. They state that the inferior thyroid artery is to be found only in the higher vertebrates. The caliber course and mode of division of the superior vessel they found to be much more constant than for the inferior. Jaeger Luroth was also of the opinion that the superior thyroid artery was the main vessel of the gland.

In the operation for goiter, as practised at the surgical clinic of Berne in which the inferior thyroid artery is exposed and ligated routinely as an important preliminary to the resection or excision of goitrous tissue the greater size of the inferior thyroid artery in goiter has been well established. In a study that includes a number of diffuse goiters made by Mastin at the Mayo clinic in which measurements of the size of the extraglandular vessels are noted the greater importance of the inferior thyroid artery in diffuse goiter is also apparent. Mastin found the diameter of the lumen of the inferior thyroid artery larger by a third on the average than that of the superior vessel. The average diameter of the inferior thyroid artery in his series was 2.78 millimeters and 1.87 millimeters for the superior. The largest inferior vessel measured 3.68 millimeters in diameter and for the superior the largest measurement was 2.38 millimeters.

It may be that in the normal thyroid the superior is the more important vessel. From data available however this point cannot be definitely determined. In his monograph on the anatomy of the thyroid gland Sobotta states that the inferior thyroid artery is usually the larger in the normal gland.

Anomalies. The superior thyroid artery which takes origin as the first branch of the external carotid is the less subject to variation. It has been known to be missing but this is indeed a rare occurrence. In 437 cases Dwight observed the inferior artery to be absent once on the right and five times on the left. Streckelsen failed to find an inferior thyroid artery on the left side four times in fifty-six instances. Its absence on the right was not observed. At operation Professor de Quervain (29) has found one of the inferior thyroid arteries to be absent in 2 to 3 per cent of cases.

Occasionally an accessory artery known as the thyroid ima also supplies the thyroid gland with blood. In seventeen postmortem specimens injected in this series such a vessel was found twice on the right side. An inferior thyroid artery was also present on the same side in each instance. In one of the cretin goiters removed at operation in this series such an accessory vessel was present on both

ides. The inferior thyroid arteries were also present.

This vessel usually described as the artery of Neubauer was found twelve times in 10 instances by Strecken and always on the right side. Gruber who has given the vessel special study finds that Neubauer described it in 1772 but states also that Haller accords its first description to Nicolai in 1725. In twenty-three observations of his own in which a thyroid ima artery was present Gruber found it only once on the left side. In two of these twenty-three instances the corresponding inferior thyroid artery was found to be absent. In 1861 when Gruber's publication appeared he was able to collect including his own cases 15 observations in which the presence of such a vessel had been ascertained. In only six of the instances was it present on the left side. Gruber observed in instance in which the vessel was present bilaterally and credits Hyrtl with a similar observation. In Gruber's case the origin of the thyroid ima artery on each side was from the internal mammary in the observation of its bilateral occurrence by Hyrtl this accessory vessel originated in the innominate artery on the right and from the aortic arch on the left. Its origin from the innominate artery Strecken found to be the more frequent. Gruber refers to its inconstant source and states that it has been found to take origin from the right and left common carotid arteries from the right subclavian the right thyrocervical axis and even from the right transverse scapular artery.

Veins. Anomalies in the number and arrangement of the veins of the thyroid are considerably more frequent than of the arteries. There are more veins than arteries. The superior thyroid vein usually empties into the common facial vein it may however empty into the internal jugular or into the lingual vein. The inferior thyroid veins do not accompany the corresponding arteries at all but empty by two to four branches that course downward into the internal jugular veins or less commonly into the innominate veins or angulus venosus. A middle thyroid vein emptying by one or more independent vessels into the internal jugular vein on either side is also usually present. Its absence on one or both sides is

however not an uncommon occurrence. When a thyroid ima artery is present Sobotta states that a vein of the same name always accompanies it.

These veins build about the anterolateral aspect of the thyroid gland a veritable venous plexus and they occasionally present at operation a rather formidable appearance. The veins of the thyroid have no valves.

Anastomoses of the arteries. The superior laryngeal artery the first branch of the superior thyroid perforates the thyrohyoid membrane usually together with the superior laryngeal nerve and establishes an important communication on the posterior side of the gland with the inferior laryngeal from the inferior thyroid artery. At the upper border of each lobe of the thyroid gland the superior thyroid breaks up into its terminal branches which usually are three in number. The main division crosses the superior pole of the gland and courses over the anterior aspect of the lateral lobe dividing into smaller branches that penetrate into the parenchyma. Another branch is directed medially over the encircling thyroid membrane and establishes an important communication with a similar division from the opposite side at the superior border of the isthmus. Occasionally this branch may not take origin as a separate division of the superior thyroid artery but springs from the first named division. The pyramidal lobe when present receives its arterial supply from this vessel. The other terminal branch of the superior thyroid descends along the posterior border of the gland and regularly anastomoses with the inferior thyroid of the same side.

The inferior thyroid artery courses over the prevertebral fascia crosses beneath and at right angles to the carotid vessels and near the lower margin of the thyroid gland on its posterior aspect divides into two or more terminal branches. It has been known to be double throughout its entire extent from its point of origin in the thyrocervical axis. The lower branch supplies the lower pole of the gland and frequently gives off a branch that crosses the trachea at the lower border of the isthmus and establishes a communication with a similar branch from the opposite inferior



Fig 1 Showing adenomatous formation well developed in a cretin goiter of a girl of seven

thyroid The upper and main terminal division of the inferior thyroid artery sends several branches into the gland gives off a few small branches to the œsophagus anastomoses with the posterior division of the superior thyroid artery and continues as the inferior laryngeal to establish an important communication with the superior laryngeal previously mentioned

The importance of the collateral vascularization established by the thyroid vessels with the ascending pharyngeal artery and tracheal and œsophageal vessels is no slight one Pettenkofer and Enderlen and Hotz have demonstrated by injections into the ascending aorta in cadavers that even after ligature of the four arteries of the thyroid at their points of origin a good injection of the thyroid vessels occurs owing to this rich collateral anastomosis (Fig 5) These surgeons have put this method into practice and perform subtotal thyroidectomy by ligature of the four thyroid vessels The preservation of the superior laryngeal and inferior laryngeal arteries is essential when such a procedure is practiced Enderlen and the late Hotz interrupt the branches of the superior thyroid artery at the upper border of the gland in order to obviate injury to the superior laryngeal vessel The inferior thyroid artery is tied as far laterally as possible to preserve the inferior laryngeal artery and at the same time to avoid injury to the recurrent laryngeal nerve

The free anastomoses of the arteries of the thyroid takes place in the capsule of the gland

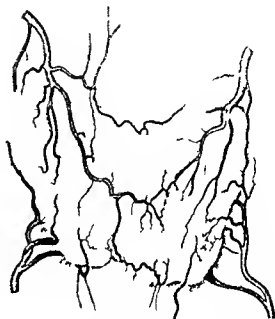


Fig 2 The arteries of the normal thyroid showing the chief anastomoses (From Landstrom)

There the branching of the arteries largely occurs and large vessels within the gland are only infrequently observed The follicular vessels terminate in rich capillary networks that completely surround the follicles of the gland Few if any communications between the larger branches occur within the gland itself Berard () demonstrated such communications between the vessels within the gland by roentgenograms of injected specimens but as Landstrom points out it is difficult to determine even with the stereoscope whether vessels actually anastomose or merely pass by one another Major was unable to determine the presence of any intraglandular anastomoses in the preparation of several corrosion specimens

The blood supply of goiter Special study of the arterial circulation of goitrous thyroids have been made by Begoune and Terry and Delamere The latter authors have investigated the arterial circulation of thyroid adenomata They observed that contiguous adenomata frequently presented deficient filling of the vessels by the injection mass When degenerative changes were present in the adenomata the injection mass was regularly found within the degenerated areas due to previous destruction of the vessels or to their increased friability

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This vessel usually described as the artery of Neubauer was found twelve times in 120 instances by Strecker and always on the right side Gruber who has given the vessel special study find that Neubauer described it in 1772 but states also that Haller accords its first description to Nicolai in 1725 In twenty three observations of his own in which a thyroid ima artery was present Gruber found it only once on the left side In two of these twenty three instances the corresponding inferior thyroid artery was found to be absent In 1871 when Gruber's publication appeared he was able to collect including his own cases 15 observations in which the presence of such a vessel had been ascertained In only six of these instances was it present on the left side Gruber observed an instance in which the vessel was present bilaterally and credits Hyrtl with a similar observation In Gruber's case the origin of the thyroid ima artery on each side was from the internal mammary in the observation of its bilateral occurrence by Hyrtl this accessory vessel originated in the innominate artery on the right and from the aortic arch on the left Its origin from the innominate artery Strecker is found to be the more frequent Gruber refers to its inconstant source and state that it has been found to take origin from the right and left common carotid arteries from the right subclavian the right thyrocervical axis and even from the right transverse scapular artery

Veins Anomalies in the number and arrangement of the veins of the thyroid are considerably more frequent than of the arteries There are more veins than arteries The superior thyroid vein usually empties into the common facial vein it may however empty into the internal jugular or into the lingual vein The inferior thyroid veins do not accompany the corresponding arteries at all but empty by two to four branches that course downward into the internal jugular veins or less commonly into the innominate veins or angulus venosus A middle thyroid vein emptying by one or more independent vessels into the internal jugular vein on either side is also usually present Its absence on one or both sides is

however not an uncommon occurrence When a thyroid ima artery is present Sobotta states that a vein of the same name always accompanies it

These veins build about the anterolateral aspect of the thyroid gland a veritable venous plexus and they occasionally present at operation a rather formidable appearance The veins of the thyroid have no valves

Anastomoses of the arteries The superior laryngeal artery the first branch of the superior thyroid perforates the thyrohyoid membrane usually together with the superior laryngeal nerve and establishes an important communication on the posterior side of the gland with the inferior laryngeal from the inferior thyroid artery At the upper border of each lobe of the thyroid gland the superior thyroid breaks up into its terminal branches which usually are three in number The main division crosses the superior pole of the gland and courses over the anterior aspect of the lateral lobe dividing into smaller branches that penetrate into the parenchyma Another branch is directed medially over the cricothyroid membrane and establishes an important communication with a similar division from the opposite side at the superior border of the isthmus Occasionally this branch may not take origin as a separate division of the superior thyroid artery but springs from the first named division The pyramidal lobe when present receives its arterial supply from this vessel The other terminal branch of the superior thyroid descends along the posterior border of the gland and regularly anastomoses with the inferior thyroid of the same side

The inferior thyroid artery courses over the prevertebral fascia crosses beneath and at right angles to the carotid vessels and near the lower margin of the thyroid gland on its posterior aspect divides into two or more terminal branches It has been known to be double throughout its entire extent from its point of origin in the thyrocervical axis The lower branch supplies the lower pole of the gland and frequently gives off a branch that crosses the trachea at the lower border of the isthmus and establishes a communication with a similar branch from the opposite inferior



Fig. 1. Showing adenomatous formation visible in a cretin goiter of a girl of seven

thyroid. The upper and main terminal division of the inferior thyroid artery sends several branches into the gland, gives off a few small branches to the esophagus, anastomoses with the posterior division of the superior thyroid artery, and continues as the inferior laryngeal to establish an important communication with the superior laryngeal previously mentioned.

The importance of the collateral vascularization established by the thyroid vessels with the ascending pharyngeal artery and tracheal and esophageal vessels is no slight one. Pettenkofer and Enderlen and Hotz have demonstrated by injections into the ascending aorta in cadavers that even after ligation of the four arteries of the thyroid at their points of origin a good injection of the thyroid vessels occurs owing to this rich collateral anastomosis (Fig. 5). These surgeons have put this method into practice and perform subtotal thyroidectomy by ligation of the four thyroid vessels. The preservation of the superior laryngeal and inferior laryngeal arteries is essential when such a procedure is practiced. Enderlen and the late Hotz interrupt the branches of the superior thyroid artery at the upper border of the gland in order to obviate injury to the superior laryngeal vessel. The inferior thyroid artery is tied as far laterally as possible to preserve the inferior laryngeal artery, and at the same time to avoid injury to the recurrent laryngeal nerve.

The free anastomoses of the arteries of the thyroid takes place in the capsule of the gland.



Fig. 2. The arteries of the normal thyroid showing the chief anastomoses. (From Landstrom)

There the branching of the arteries largely occurs and large vessels within the gland are only infrequently observed. The follicular vessels terminate in rich capillary networks that completely surround the follicles of the gland. Few if any communications between the larger branches occur within the gland itself. Berard (2) demonstrated such communications between the vessels within the gland by roentgenograms of injected specimens, but as Landstrom points out, it is difficult to determine even with the stereoscope whether vessels actually anastomose or merely pass by one another. Major was unable to determine the presence of any intraglandular anastomoses in the preparation of several corrosion specimens.

The blood supply of goiter. Special study of the arterial circulation of goitrous thyroids have been made by Begoune and Ferry and Delamere. The latter authors have investigated the arterial circulation of thyroid adenomata. They observed that contiguous adenomata frequently presented deficient filling of the vessels by the injection mass. When degenerative changes were present in the adenomata, the injection mass was regularly found within the degenerated areas due to previous destruction of the vessels or to their increased friability.

Fig. 3

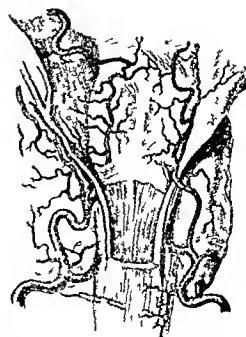
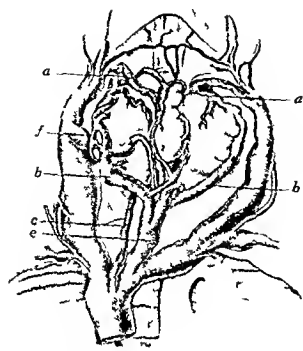


Fig. 4. The anatomical drawing of the thyroid gland and its blood supply. The gland is shown in the center, with the arteries and veins branching out to it. The labels are: a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z.

Anna Begoune studied the intraglandular blood supply of the thyroid gland in diffuse hypertrophy and in colloid goiters exhibiting degenerative areas as well as in adenomatous and cystic goiters.

In her studies she found that the blood supply of the hyperplastic gland was much like that of the normal thyroid. In the colloid goiter she observed no great variation from the normal. Where large accumulations of colloid were present the vessels frequently were compressed and the anastomoses between some of the vessels were erased. The blood supply of the cellular adenomata Begoune found to be the poorest. Here the finer vessels were the first to disappear. In cystic goiters she found the zone immediately about the cyst to be poorly vascularized. Small vessels were occasionally observed to penetrate the cyst wall.

METHOD OF STUDY

The source of the material for this study comprised of operatively removed specimens as well as goiters obtained at necropsy. The injection of the latter was made possible by the courtesy of Professor Wegelin of the Pathological Institute of the University of Berne.

The method most frequently employed in this study was the intra arterial injection of a gelatin carmine mass. A few venous injections with the gelatin carmine mass were also made.

The injection mass was brought into solution by gentle heating on a water bath to 50 degrees C. The injections were usually made with the removed specimen immersed in saline at a temperature of about 40 degree C. Some injections were made with the thyroid *in situ* in a few postmortem specimens. In the operatively removed specimens the superior thyroid artery of the lobe best preserved intact was usually injected. Occasionally the inferior was used and sometimes both the superior and inferior arteries were injected. In the postmortem specimen all the arteries were

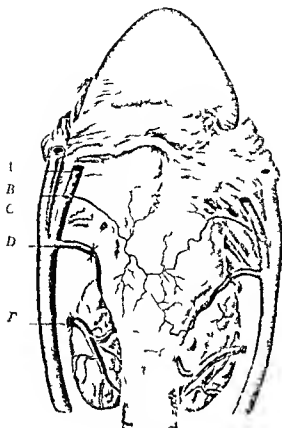


Fig 5 Injection of four thyroid arteries through the collateral circulation of the gland after ligation of the four thyroid arteries. A Left carotid artery. B Common carotid artery. C Internal carotid artery. D Superior thyroid artery. E Inferior thyroid artery (from Underhill and Holtz).

usually injected. A metal syringe was employed and gentle pressure was used. A manometer to determine exactly the amount of pressure employed was not used. On completion of the injection the specimen was placed at once into ice water to permit of quick solidification of the injection mass.

India ink diluted by the addition of about one third as much water was also used for the venous and intra-arterial injections of some operatively removed specimens. A little uncolored gelatin dissolved by heating was routinely added to this injection mixture.

Roentgen studies were made of a few thyroids after the intra-arterial injection of opaque media. Mercuric oxide and Hill's white mass were the contrast masses employed. In most instances the size of the particles was such that the capillaries were not filled. Two pictures in which the capillaries were nicely filled were also obtained.



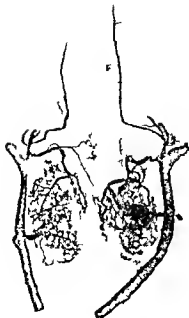
Fig 6 The branching of the thyroid vessels is well illustrated in the roentgenogram. The larger arteries are in the upper part of the image. The smaller arteries are in the lower part of the image.

In one instance a celloidin corrosion preparation of a cretin goiter obtained at necropsy was made.

The tissues employed for histological section were fixed in 4 per cent formalin. Small pieces from different parts of the gland were subsequently removed and embedded in celloidin. The cut sections (15 to 30 micra in thickness) were stained in each instance with hematoxylin and eosin and also with van Gieson's stain.

SUMMARY OF RESULTS

Thirty nine thyroid glands were injected in this study. Twenty two of these represent operative material in the remaining seventeen instances the thyroid was obtained at autopsy. In only thirteen of these thirty nine cases did the goitrous tissue come from individuals afflicted with cretinism. Ten of these goiters were obtained at operation from as many patients with cretinism. The other three concerned so called half cretins. In two of these instances the thyroid was obtained at


$$\frac{1}{t} \quad \lambda \quad t \quad 1 \quad t \quad 1 \quad f \quad h \quad 1 \quad f \quad h \quad 1 \quad f$$

The youngest patient in the series was a cretin girl of 7 years; the thyroid from the eldest subject was obtained at necropsy from a non cretin aged 94. The oldest known cretin in the series was 64. Frequently the age could not be determined however because of the mental status of the patient.

The inferior thyroid artery was found to be absent in only one instance (left side) in the sixteen necropsy specimens dissected. The

In the injected postmortem specimen a good injection of the tracheal laryngeal and oesophageal vessels was constantly observed

In a few injections made into the thyroid veins of operatively removed specimens the greater friability of the veins over that of the arteries was noted. Rupture of the vessel and dissemination of the injection mass into the adjacent tissue was not infrequently observed (Fig 8). Though seen also after intra arterial injections it followed with considerably less regularity.

Only one corrosion preparation was made in this study. Careful inspection of the specimen shows that a few anastomoses of the so called interlobular arteries are present. True no anastomoses of the larger divisions of the primary branches were made out.

In one cretin patient of 46 years in this series marked pulsations of the thyroid vessels could be seen and felt. A small artery, running obliquely from right to left pulsed vigorously and could be seen through the skin (Fig 9). At operation this was found to be a branch of the main division of the right superior thyroid artery that ran obliquely across the isthmus to establish a communication with the left inferior thyroid artery. Such an anomalous anastomosis has previously been described by Begoune and Landstrom (2).

The basal metabolism of this patient was normal ($+1$ per cent) and no clinical symptoms of hyperthyroidism were present. The



Fig. 8. An injection onto the superior thyroid gland of a cretin goiter. Discoloration of the injection mass in the gland tissue because of the friability of the cretin.

left lobe which was used for injection weighed 58 grams. Its superior thyroid artery was 6 millimeters in diameter and that of the inferior 9 millimeters. Grossly this goiter was distinctly adenomatous on cut section.

Doubler has already reported from this clinic four instances in which such pulsating vascular goiters were present in children with some physical features of cretinism and low basal metabolic rates. Occasionally a few concomitant symptoms suggesting hyperthyroidism were present. Pathologically these were all diffuse goiters in which the diagnosis of diffuse hyperplasia (exophthalmic goiter) was made in some instances.

Sections of injected specimens colored with van Gieson's stain make beautiful preparations for microscopic study especially when India ink is employed for the injection. The glandular elements present a greenish brown appearance and the connective tissue spaces and the blood vessels are bright red. The intimal layer of the blood vessels is stained a dark brown while the muscular layer takes the same hue as the connective tissue. The blood in the vessels when not replaced by the injection mass is a pale brown. The colloid in the follicles is stained a pale brown and occasionally a deep brown.

Williamson and Pearse state that they rarely were able to inject the capillaries by arterial

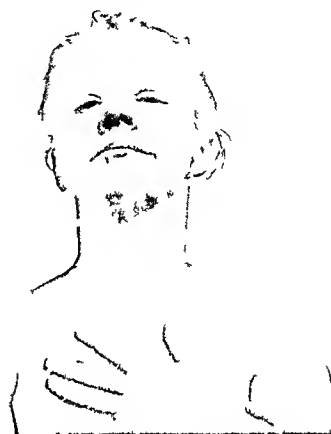


Fig. 9. The pulsating thyroid of a cretin with 40 ter. The normal artery running obliquely from right to left and been beneath the skin.

injections. In only one out of each twenty instances were they able to get nice capillary injections. I encountered no difficulty in this regard and usually obtained sections in which the capillaries were well filled. Occasionally areas were present in which a few of the smaller vessels had escaped injection.

In the normal thyroid gland connective tissue processes are seen only where blood vessels are present. Flint states that in the fetal thyroid these processes may constitute septa that divide the gland into fairly definite structural units. Employing the same dissection of partially digested thyroids of adults he was unable to determine the presence of such definite structural units. Williamson and Pearse have recently referred to a functional unit in the gland which they describe as a lymphatic sinusoid.

Major recognizes in the thyroid gland certain vascular units of which the follicular is the smallest. An aggregation of an inconstant number of follicles constitutes the lobular or



Fig. 1. A section of the thyroid gland showing the follicular structure. The follicles are lined by a single layer of cuboidal epithelial cells. The interior of the follicles is filled with colloid. The connective tissue between the follicles is stained pink.

next smallest unit. Collections of lobules marked off from similar groups of lobules by fairly dense connective tissue processes form the next larger vascular unit which Major call the lobular unit. It does not correspond to a definite structural unit. The first and largest vascular Major recognizes as the lobe itself.

Each follicle has a small artery of its own the follicular artery which ends in a rich capillary network completely surrounding the follicle. These follicular arteries or vessels of the fourth order in turn are divisions of the lobular vessel which run in a somewhat larger connective tissue process between aggregations of follicle. In denser strand of connective tissue septa of the second order a rather arbitrary division give off the lobular artery of the third order already mentioned. The vessel of the first order are represented by the anastomosing arteries in the capsule.

In the normal thyroid gland Major found that the capillaries of the follicular network averaged 0.008 millimeter in diameter. This



Fig. 2. A section of the thyroid gland showing the vascular structure. The image shows a dense network of blood vessels, including arteries and veins, surrounded by connective tissue. The vessels are stained pink, and the surrounding tissue is stained blue.

measurement for the follicular arteries was 0.005 millimeter for the lobular vessels 0.030 millimeter and for the arteries of the second order 0.100 millimeter. The arteries of the first order in the capsule had an average diameter of 0.150 millimeter.

The difficulty of determining any average size for the larger orders of arteries in goiter is readily appreciated when one considers the varying size of the chief vessels as well as of the goiter itself. However even a cursory examination of a few sections would serve to indicate that these measurements of the normal will not hold for adenomatous goiter.

Numerous determinations of the diameter of the various orders of vessel have been made of each preparation used for histological study. Near the surface of the gland in the capsule variations from 0.170 to 0.180 millimeters were observed. The latter large capsular artery was found in the non cretin goiter previ-

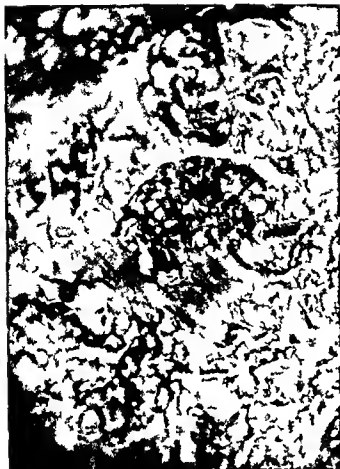


FIG. 12. The capillary network in beginning adenoma formation (from another area of same gland as Figure 1.)

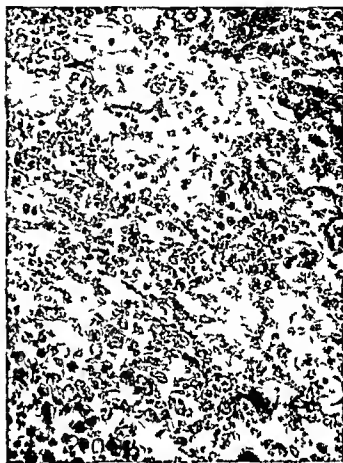


FIG. 13. An atrophic area in a cretin goiter. These micro follicular acini are frequently seen in cretin thyroid. The proliferation of the connective tissue and the scarcity of the capillary vessels are apparent. (Carminie gelatin injection mass—hematoxylin eosin stain) ($\times 40$)

ously mentioned in which the left inferior thyroid artery had a diameter of 9 millimeters. In many of the cretin goiters measurements of 0.680 millimeter were frequently seen. Diameters for these surface arteries of 1 millimeter or slightly more were not infrequently observed.

For vessels of the second order in the dense strands of connective tissue within the gland variations of from 0.085 to 0.425 millimeter were found. Considerable variation in the size of such vessels was constantly present even within the same gland. Measurements varying from 0.116 to 0.348 millimeter for such vessels in different septa of the same gland were obtained in one section of a cretin goiter.

Variations between 0.09 to 0.085 millimeter were found in the diameters of interlobular vessels. Most of the measurements were grouped between 0.034 and 0.058 millimeter for these vessels in both the cretin and the

ordinary adenomatous goiter. In a few cretin goiters a measurement of 0.072 millimeter was obtained not infrequently for this diameter.

The most constant finding for the diameter of follicular arteries was between 0.023 and 0.09 millimeter in both cretin and non cretin goiters. Variations however between 0.016 and 0.0435 millimeter were observed in this series. Measurements of 0.0145 millimeter for the follicular artery were common in the normal glands examined.

The diameter of capillaries in the follicular network was determined in several areas in each preparation. The most constant finding for the diameter of the capillaries was from 0.0087 to 0.0145 millimeter in areas where the acini were distended by accumulation of colloid. This diameter was occasionally found to be as low as 0.0003 millimeter. In some

narrowed and compressed. The capillaries in the interfollicular network are in consequence collapsed. Where collagenous processes of connective tissue are present in abundance and where marked fibrotic changes occur the vessels also suffer as a result. Here capillary communications become erased and follicular arteries are not infrequently found occluded by the constricting connective tissue. Then again, in areas of such glands where these changes and increases in the interstitial tissue are less prominent dilatation of the smaller vessels may also be seen. In those thyroids where there is no great deviation from the normal in the amount and quality of the interstitial tissue the capillaries of the gland have the arrangement present in the normal. In areas of epithelial hyperplasia such as are seen even in the cretin goiter as well as in the euthyroidic adenomatous goiter where the disposition of the connective tissue is more like that seen in the normal gland the capillary network surrounding the follicles is also more like the normal.

The poor blood supply of adenomatous or degenerating adenomatous areas presenting cystic or other changes is well known. It has already been pointed out that the cretin goiter has no pathognomonic pathological picture. It is usually adenomatous in character and as the studies of Wylder (43) and Wegelin (40) have shown cretin goiters show degenerative changes earlier and in excess of what occurs in the ordinary adenomatous goiter. Similarly here a poor vascularization of adenomatous areas with marked connective tissue proliferation or other degenerative change is to be expected.

Getzowa has studied the histology of atrophic thyroids of cretins without goiter. In several specimens she was unable to ascertain the presence of capillaries in the connective tissue stroma. The marked sclerosis of the interstitial tissue present in such glands would of course account for the scarcity of the vessels observed.

Degenerative changes in the walls of the arteries themselves were frequently seen in this study. These changes are practically limited to the intima. Intimal thickening of such grade that the vessel was occluded or

the lumen almost obliterated occurs not infrequently. The capsular and arteries of the second order are chiefly concerned, but the follicular and interlobular arteries do not escape. The wall of one large capsular artery presenting this degenerative phenomenon was 0.90 millimeter in thickness.

The two larger orders of arteries in the thyroid frequently have a very thin muscular layer such that these arteries may be indistinguishable from the accompanying veins. These latter vessels in the thyroid are regularly present without a muscular layer the wall of the vein being constituted by intima and adventitia only. The interlobular and follicular arteries however usually have a fairly well developed muscle coat.

In the two larger orders of arteries the presence of thickening and degenerative changes in the intima serve to establish the identity of the arteries. Splitting of the elastica interna in the larger arteries near points of division is also not an uncommon occurrence.

Utknecht has described the finding of regressive changes in the vessels of adenomatous goiters exhibiting degenerative phenomena as a common event. Isenschmid studied the thyroid gland of childhood and states that arteriosclerotic changes in the vessels are not uncommon after the first year of life. Necrosis of the elastic fibers in the intima, followed by hyaline connective tissue changes and calcification he observed frequently in the arteries of the thyroid of children. This process he found to occur with greater regularity in the thyroids from Berne in the goiter endemic than in thyroids of children from Kiel where goiter is not endemic. Cora Hesselberg has even found arteriosclerotic changes in the arteries of the thyroid of the newborn.

Small projections from the intima into the lumina of some of the arteries were often seen in the adenomatous goiters of both cretins and non cretins examined in this series. These buds are most frequently seen in the middle sized arteries and especially near points of division. They appear to consist of the intima alone (Fig. 10). Horne was the first to describe them in the fetal thyroid and in the arteries of adenomatous goiters. Schmidt subsequently showed that these buds were a

fairly normal occurrence in the arteries of the normal thyroid Wegelin Getzowa and de Coulon have already described these buds in the arteries of cretin goiters Wydler failed to observe them Isenschmid cautions however that their presence can be determined only in thin sections They do not occur in the veins Their significance is not known

The large extraglandular vessels seen in the cretin goiters probably represent a compensatory effect—an effort to bring as good a blood supply as possible to the adenomatous areas It has previously been pointed out that adenomatous goiters have larger vessels than those seen in diffuse enlargement of the thyroid

The enlargement of the afferent and efferent vessels in tumor formation appears to be characteristic It is especially to be seen in rapidly growing tumors such as sarcomata as well as in large tumors of various kinds (hypermelioma lipoma etc.) In intra abdominal tumors to which the omentum has become attached marked enlargement of the omental vessels is even occasionally observed

Adenomatous formation in the thyroid is quite generally looked upon as being a neoplastic process of benign nature In endemic goiter areas the incidence of adenomata in the thyroid is of course far greater than in regions free from goiter Wegelin has found that more than 75 per cent of patients over 40 years of age coming to necropsy at Berne show adenomatous formation in their thyroid In patients over 80 years this figure reaches 100 per cent He also points out that even in goiter free areas the incidence of adenomata increases with age In both the normal thyroid as well as in the adenomatous goiter therefore interstitial connective tissue change commensurate with the age factor are to be expected Consequent and parallel alterations in the disposition of the smaller vessels necessarily follow

There appears to be no direct relation between the size of the goiter and its arteries In the cretin goiters however large extraglandular arteries accompany lesser enlargements of the thyroid than in the ordinary adenomatous goiter A diameter of 9 millimeters for the inferior thyroid artery of the

non cretin goiter was observed only once in this series Its occurrence obtained in the instance of a very large goiter the weight of which was not ascertained Such a measurement was observed several times for cretin goiters in which the lobe obtained for injection weighed only 58 70 or 95 grams

The call upon the vessels by a growing tissue alone would therefore inadequately account for the larger size of the arteries of the cretin goiter The excessive response in the form of unusually large vessels manifested in such patients probably also represents in part the answer to the demand of a physiologically hypo active tissue for more blood The giant capillaries previously described probably find their origin in the same explanation

That the thyroid tissue of cretins is relatively inert is demonstrated in their low metabolic rates as well as in the negligible iodine content of such tissue The diminished biological activity of tissue from cretin goiters has also been well shown by the tadpole feeding experiments carried out by Branovsky in this laboratory Thyroid tissue from cretin goiters showed a markedly decreased tendency to influence the rate of development and growth of tadpoles as contrasted with the effect of the feeding of normal thyroid tissue

An effective call for a greater blood supply however can come only from tissue capable of hypertrophy The hyperfunctioning tissue of diffuse hyperplasia undoubtedly is also able to create such a demand In the atrophic thyroid glands of cretins without goiter such large vessels are not encountered

In the diffuse hyperplasia of exophthalmic goiter in which the thyroid arteries are usually obtained than are those of adenomatous goiters the smaller lumina of the vessels are probably more than compensated for in the increased rate of circulation Blalock and Harrison have recently shown that the cardiac output is increased in dogs who are given thyroid extract In thyroidectomized dogs they found the cardiac output diminished and postulate that the same probably occurs in myxedema Although a diminished rate of circulation or diminution in the cardiac output has not been demonstrated in cretins

over what obtains in normal individuals cretinism probably partakes in this particular of the features of myxoedema Professor de Quervain has already pointed out that these are factors for which the arterial circulation of the cretin goiter must also compensate

SUMMARY AND CONCLUSIONS

What is known concerning the blood supply of the normal and the pathological thyroid gland has been reviewed The normal thyroid gland is provided with a more liberal and free source of arterial flow than is any other gland of its size in the body In goiter the inferior thyroid artery is the larger and the more important vessel An accessory or thyroid ima artery occurs in about 10 per cent of instances and usually on the right side Free anastomoses of the chief arteries of the gland occur in the capsule Anastomoses between the arteries within the gland itself are thought not to exist but a few such communications were observed in our one corrosion specimen

The alteration in the disposition of the smaller blood vessels in goiter is intimately related to and dependent on the changes in the connective tissue stroma in which the vessels run In adenomatous goiter where such changes are common deviations from the normal size and distribution of the interlobular follicular and capillary vessels are frequent In the goiter of the cretin where degenerative changes are especially prevalent transition from the normal arrangement of these smaller vessels is particularly likely to obtain Degenerative changes in the vessel walls of arteries of all orders are common in adenomatous goiters

The large extraglandular vessels so frequently seen in cretin goiters represent a compensatory attempt to insure a good blood supply to a benign neoplastic process of a hypofunctioning tissue in which the alterations in the stroma have made a normal nutrition impossible In areas of cretin goiters where no departure from the normal is present in the quality and quantity of the connective tissue stroma giant capillaries may obtain in the interfollicular network Less frequently such dilated capillaries are also observed in non cretin adenomatous goiters

The vascular system of the goiter of cretins is not peculiar to cretin goiters alone Its counterpart though in less degree is observed in the vessels of ordinary adenomatous goiters With its biologically inert tissue the goiter of the cretin is not able to eke out of its abundant blood supply a nutrition sufficient for normal function

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ADENOMA OF THE KIDNEY

HERMAN L. KRETSCHMIR, M.D., F.A.C.S. AND CARL DOHRING, M.D., Chicago

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THE conventional description of adenoma of the kidney may be summarized as follows. The tumor is small, it presents no clinical symptoms, hence has no clinical significance, and it occurs most frequently in kidneys affected with interstitial nephritis. This in a general way expresses the views of Israel Thomson Walker, Young, and many others. On the other hand, Judd and Simon are of the opinion that clinical symptoms are striking in those instances in which large benign adenomata of the kidney are present.

In this paper will be considered only the large benign adenoma—a rare type of renal neoplasm. Its rarity combined with its unusual size should constitute full justification for the following report.

CASE REPORT

Miss F. M., age 4 years. Family history was negative. Patient has always been in very good health. In June 1920 she noticed an enlargement on the right side of the abdomen but she did not consider it of sufficient importance to consult a physician. Three or four months later she called the attention of her family physician to the swelling because of its size. No pain or discomfort or any general systemic disturbance occurred until within the last few weeks when there were transient slight aching pains and discomfort on the right side. The mass according to her statement progressively increased in size and at no time were large quantities of urine passed.

Examination (H. L. K.) January 2, 1922 disclosed a large tumor mass on the right side, the most prominent part of which was just above the umbilicus and extended a little beyond the median line three fingerbreadths above the top of the umbilicus and one fingerbreadth inside of the anterior superior spine. The mass was smooth, not tender, was freely movable, and could be displaced without difficulty. When displaced it moved toward the kidney area but deep inspiration moved it back to its original position. It could also be displaced downward into the pelvis. Patient was advised to go to the Presbyterian Hospital but did not take this advice. She returned two years later, the condition being practically the same. She entered the hospital on March 25, 1924.

Physical examination (two years after first examination) showed patient to be well nourished and apparently in good health.

Abdominal examination disclosed a large firm tumor mass which occupied almost the entire right half of the abdomen extending from about inches above the pelvic brim up to the costal arch and medially to the midline. The mass was globular in shape, was not attached to the anterior abdominal wall and was about 10 inches in diameter. It was not noticeably respiratory motile and seemed to be attached posteriorly to the kidney region. There was no evidence of fluctuation and pain was not present on manipulation.

Pelvic examination showed the uterus pushed deep into the true pelvis anteverged with the cervix pointing directly downward. The uterus was freely movable and apparently was not connected with the broad ligament. The ovaries were not palpable.

Blood examination showed red blood cells 4,900,000, leucocytes 6,000, hemoglobin 95 per cent. Blood pressure systolic 115, diastolic 75. Urinalysis of voided specimen showed urine cloudy, acid reaction, albumin, some blood cells, no sugar, pus 3 plus, no casts, but some epithelial cells.

Cystoscopic examination showed the bladder and ureteral orifices normal. Both ureters were catheterized without difficulty or obstruction. A prompt flow of urine was obtained.

Examination of catheterized specimens showed

| | L
pe | Size
mm | C
lit | U
rea | C
t | R
d
blood | II |
|--------------|---------|------------|----------|----------|--------|-----------------|----|
| Bladder | 50 | Sterile | | | 0 | ++ | |
| Right kidney | 90 | Sterile | 1.05% | | 0 | ++++ | |
| Left kidney | 70 | Sterile | 87% | | 0 | 0 | |

Thulin test showed

| | R
ht
p | L
ft
p |
|-------------------|--------------|--------------|
| First 15 minutes | 5 | 12 |
| Second 30 minutes | 8 | 18 |
| Total 45 minutes | 13 | 30 |

Roentgen ray examination. The right kidney region is covered by a large soft parts shadow which extends from the eleventh rib to the crest of the ilium and suggests a much enlarged kidney shadow. The right catheter extends to the level of the second lumbar vertebra, it curves medially and over lies the spinous processes of the third, fourth, and fifth lumbar vertebrae. The kidney outline is normal. The left catheter extends to the level of the third lumbar vertebra and is in normal position. No urinary stone shadows are seen. The examination disclosed no bone change.

A right pyelogram (Fig. 1)—film taken with the patient lying down—shows the right kidney pelvis incompletely filled. It lies at the level of the first lumbar vertebra in the upper part of the large soft

parts shadow previously reported. This shadow is again visualized and extends from the eleventh rib to 1 inch below the crest of the ilium and practically fills the right side of the abdomen. The catheter is inserted into the bladder.

A second plain film (Fig. 2)—film taken with the patient standing—shows the kidney pelvis at the level of the fourth lumbar vertebra. There is a letter filling which shows a little clubbing of the ribs. The soft parts mass now extends from the 12th lumbar level into the bony pelvis to the level of the iliac crest. It covers the area from the midline of the right ilium to the left border of the sacrum measuring 8 by 24 centimeters. The catheter extends from the middle of this shadow and into the right border of the spine probably because the mass is situated over the ureter instead of pushing it one day before. The right lobe of the liver is still visible its lower border lying 6 centimeters below the eleventh rib shadow. The kidneys are palpable at the upper margin of the shadow produced by the kidney tumor.

On the basis of the findings a diagnosis was made of kidney tumor in the right kidney which shifts with the change of position of the patient.

Operation performed March 8, 1924. The usual 11th lumbar incision as made. A large round tumor mass felt which was attached to the lower pole of the kidney through the lower margin reaching to the 12th rib level. The mass as delivered through the incision measured 10 inches in diameter. A horizontal line of demarcation between the tumor and the kidney substance could not be made. Removal of the kidney was effected by resection through the incision being through the kidney substance and the inferior calyx. There was a little hemorrhage. The edges were properly sutured and sutured with heavy catgut. Because of the great mobility of the kidney as a result of the weight of the tumor which was attached to the inferior pole it was decided to do a nephropexy. A cigarette drain was left in the wound. The patient left the hospital 3 days later after an uneventful recovery. Six months later she was operated for fibroid of the uterus. She was seen with the patient in the hospital at which time examination of the abdomen revealed a large cystic mass and the case was no longer current. Six months after the onset of her trouble she died.

On the basis of the specimen the tumor mass in the right kidney measured 15 by 15 by 15 centimeters. It was a gelatinous mass entirely encapsulated by a tough blue white membrane in which the arteries and veins were 1 millimeter in diameter. The capsule was as firm as the tumor. The outer surface was smooth and the inner surface was lobulated. A small portion of the kidney by centimeter crosses the upper pole of the tumor and is definitely enclosed between

two layers of the outer capsule. The tumor mass is uniformly yellow and soft throughout. It is everywhere surrounded by an inner tough blue capsule 1 to 1 millimeter in thickness to which the soft tumor tissue is attached. There are two or three islands of bluish cartilaginous material scattered throughout the soft tumor tissue. Grossly there are numerous blood vessels near the central part of the tumor which center about one of the cartilaginous islands. The tumor tissue is uniform in consistency throughout being as solid at the center as at the periphery beneath the capsule. Grossly there is no evidence of degeneration.

Microscopic sections. The kidney tissue is unchanged and contains no evidence of tumor tissue. The capsule of the tumor is composed of dense fibrous tissue.

Sections from the tumor mass show it to consist of masses of cells in more or less alveolar arrangement on a connective tissue framework. The cells are cuboidal or hexagonal in shape. The nuclei are large, the chromatic material abundant and the nuclei are markedly prominent. There are a few mitotic figures scattered throughout. In some parts of the section the cells form short tubules with and without lumen. These cells are similar to each other and are usually cuboidal. Connective tissue is denser in one fourth of the slide and in it are embedded masses of cuboidal and polygonal cells but all these cells bear relation to a basement membrane. Along one edge of the section there is granular structure less material resembling products of degeneration. The microscopic structure of the tumor suggests an adenoma of the alveolar type with some tubule formation.

Histological diagnosis: adenoma of the kidney.

REVIEW OF THE LITERATURE

The case described added to those found in the available literature brings the total number up to 17. Of these 17 cases 8 were females and 7 males and in 2 cases the sex was not stated.

AGE

The age incidence does not seem to be a very constant one. The youngest patient on record a female 11 months of age was reported by Czerny and Kynoch's patient was 16 months of age. The oldest case a male 70 years of age was reported by Binney. It can readily be seen that the age incidence has no bearing on the cases.

CLINICAL DATA

The majority of these cases were found in the older literature and were reported at a time when urological cases were not carefully

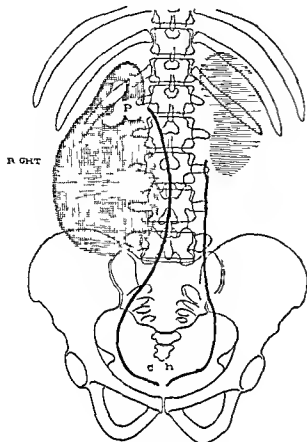


Fig 1 Pyelogram made with the patient lying flat The pelvis is opposite the first lumbar vertebra

studied by means of the roentgen ray of cystoscopy of ureteral catheterization and of the pyelogram hence the symptomatology is vaguely expressed and many of the reports are decidedly incomplete Some of the cases were simply autopsy specimens and contain little or no data

The one constant symptom in this group is the presence of an abdominal tumor

Blood in the urine is mentioned in 8 cases pain in 6 and anemia in 3 The tumor was on the right side in 10 cases on the left side in 4 cases and in 3 cases no mention was made of the side

In the pre pyelogram days physical examination was the only means of establishing a diagnosis In the case reported by Judd a filling defect was found in the pyelogram and the diagnosis of tumor was based on the picture In the case reported here the tumor originated from the lower pole of the kidney and grew down into the iliac fossa and the pelvis There was no encroachment on the kidney pelvis hence no filling defect such as is usually

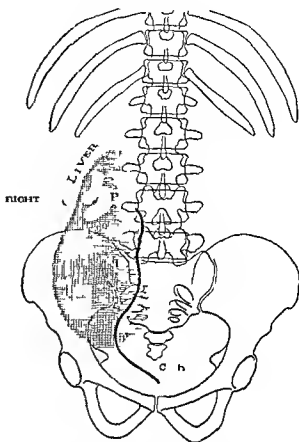


Fig 2 Pyelogram taken with the patient standing Note descent of tumor into the right iliac fossa Pelvis situated opposite the third lumbar vertebra The edge of the liver is well below the costal arch

found in tumors of the kidney occurred The interesting thing in the pyelogram was the dislocation of the pelvis The X ray film taken with the patient in the standing position showed the descent of the kidney pelvis into the iliac fossa The suspicions entertained prior to the physical examination that the tumor was of renal origin were confirmed by the examination

Nevertheless before the patient came under our observation a diagnosis of ovarian cyst had been made The size of the tumor is the only distinctive sign that the kidney is the site of a benign tumor therefore a pre operative diagnosis unless the distinctive sign is taken into consideration is likely to be wrong

The case herewith reported was seen within the past 3 months 8 years after the onset of her trouble and 4 years after the operation She is well and examination showed no sign of recurrence One of the patients reported by

ADENOMA OF THE KIDNEY

| A h | Ag | E | P | E | E | Cl | L | U | P | P | Op | P | R | Its |
|----------|----|----|---|---|---|----|------|----|----|-----|----|----|---|-----|
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| 1 II | F | 39 | | + | + | P | | | | P | ph | P | D | h |
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| 2 II | F | | + | + | + | R | | N | Lo | | N | Ad | L | y |
| K | F | | + | | + | R | | | | | N | Ad | W | l |
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| W | M | | + | + | + | L | | | | | T | Ad | R | y |

Morris a female 48 years of age was alive and well 10 years after the operation

THREE BENIGN ADENOMATA OF THE KIDNEY

Large benign adenomata of the kidney are not of frequent occurrence. Of 114 renal tumors collected by Binney in reviewing the literature 10 were found to be adenomata of various types. Binney found 3 adenomata among 14 renal tumors in a series collected at the Massachusetts General Hospital. Garceau mentions 4 large papillary adenomata among 4 renal tumors at the Massachusetts General Hospital and Boston City Hospital in 10 years. Judd has collected 7 cases of benign adenomata from the literature and added one

of his own. According to Morris benign new growths in the kidney scarcely form 6 per cent of renal tumors. Of 51 collected cases Aldibert found 48 were malignant and only 3 benign. Between January 1, 1901 and January 1, 1913 83 patients with tumor of the kidney were operated upon in the Mayo Clinic. Benign tumors (adenoma, lipoma and angioma) were present in only 3 cases.

PATHOGENESIS

The pathogenesis of simple adenomata is obscure and uncertain. They are found both in the healthy kidney and in the kidney with chronic interstitial nephritis. Some arise probably as Albarran suggests from

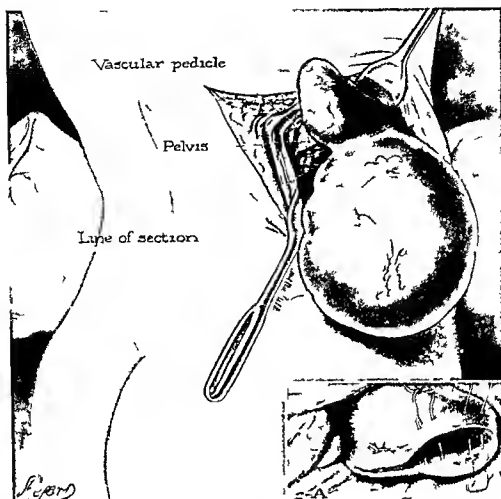


Fig 3 Showing line of section \ Insert showing method of closure

rests of the renal tubules or as Pilliet indicates from functionally isolated elements due to an error in development others possibly from remnants of the wolffian body That all adenomata do not arise from the same source is evident Morris states that the epithelium in one of his cases is typically renal and in long tubes whereas James Bell reports a case in which the epithelium is composed of large polygonal cells with a clear homogeneous cytoplasm distinctly different from normal kidney tissue cells MacCallum believes that the tumor cells are the offspring of cells destined to form kidney substance but diverted to the formation of a tumor at an early stage of development Israel in his monograph on surgery of the kidney and ureter quotes Borst as follows The term adenoma has so far no theoretical significance as the proof that it takes its origin from the renal tubules has not been proved One has much more the impres-

sion that it perhaps takes its origin from an unused part of the *Nierenanlage*

SIZE

Renal adenomata may vary in size from less than 1 millimeter to 20 centimeters in diameter The smaller ones are grayish red nodules sharply demarcated and encapsulated usually lying in the cortex just under the capsule but occasionally found in the medullary portions They may be single or multiple solid or cystic and consist of small tubules packed closely together or ramifying glandular structures in which the cells are much smaller than those of the convoluted tubules Glomeruli have not been found Symptoms are lacking and frequently their presence is only ascertained at autopsy

When adenomata reach a size large enough to form tumors they give rise to symptoms of pain pressure discomfort and sometimes

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TUMORS OF THE SALIVARY GLANDS

CICILIE WAKKLY TUMORS OF THE SALIVARY GLANDS LONDON ENGLAND

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ANGIOMATOSIS OF THE SALIVARY GLANDS

ANGIOMATOSIS of the salivary gland is a rare condition but by no means unique. There are several cases recorded in surgical literature. Virchow in 1889 refers to two cases of parotid angioma. The condition occurs mostly in children and in those cases which have been described in adults there is generally a history of the condition having been present since birth. For example, Gascoyen described a case of an angioma of the parotid in a man aged 44 years. The tumor was congenital and gradually increased as age advanced to such a size that it eventually caused the death of the man by suffocation. Clement Nicory described a case of an infant aged 9 months which was operated upon by Clogg in which the whole of the right parotid gland was involved and complete excision was impossible.

I have seen only one case and that occurred in a male infant aged 3 months who was admitted to the Belgrave Hospital for Children with a large tumor the size of a pigeon's egg, situated just in front of the angle of the lower jaw on the right side. The tumor was increased in size; it was more or less circumscribed and the skin was of a purplish color transmitted from the tumor beneath it. The tumor was excised by means of a T-shaped incision; there was no definite capsule and hemorrhage was free. The tumor was definitely lobulated and macroscopically resembled fat with many dilated and tortuous vessels running in every direction through it. Microscopically the

glandular structure of the lobules was seen to be replaced by a delicate network of capillaries the walls of which consisted of a single layer of endothelium.

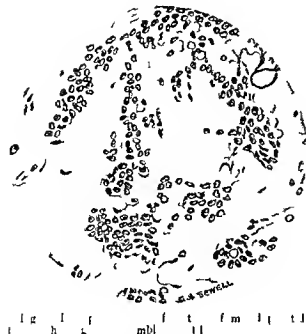
Magnac described a case of angioma of the submaxillary gland in a girl aged 5 years. A swelling had been present below the right side of the lower jaw since birth and at the age of 5 it commenced to increase in size. It was thought to be a retention cyst of the submaxillary gland. After excision the tumor was found to be an angioma which was in close contact with the gland but had not penetrated it.

ADENOMATA

Adenomata of the salivary glands are rare; they occur more frequently in the parotid than the other glands. They are always encapsulated and may be cystic or solid. They are usually alveolar in structure and reproduce the form of the gland. There can be no doubt that these rare tumors show a tendency to undergo malignant change into adenocarcinoma.

MIXED TUMORS OF THE SALIVARY GLANDS

These tumors are most common in the parotid gland and are characterized by the presence of spaces containing material resembling cartilage (Fig. 1). They have been called by a variety of names: embryoma, endothelioma, or mixed tumor. There has been and still is an active controversy as to the nature of these tumors. They were at first thought to be



purely epithelial in origin. Virchow considered that the cartilage was formed by a process of metaplasia from connective tissue while Cohnheim stated that it was a remnant of the branchial arches which became displaced during fetal life.

It was Wartmann who first set forth the endothelial theory; he considered that the polyhedral cells were derived from endothelial cells of the lymphatic vessels. The endothelial nature of mixed parotid tumors was widely accepted except in France. Today the endothelial theory has been abandoned altogether for the cells show no definite endothelial character under the higher powers of the microscope and more delicate contrast staining. At the present time the consensus of opinion is that the vast majority of so-called mixed tumors are entirely epithelial in nature. This conclusion is largely due to the investigation of Kennen and Fry.

The tumor is derived most frequently from the duct of the gland but in a few cases from the secretory cell.

Fry considers that the mucinous material which is such a prominent feature of most of the tumors is a true secretion of mucin from the tumor cells and that this is only an exaggeration of a normal function of the gland cells.



Fig. 1. H. H. p. (X 40) fm. clp. tdt. m. Th. pth. l. cell. nb. dly.

No cartilage is to be found in these tumors but in the substance which has been described as cartilage the matrix is formed by a change in the mucin of the tumor whereby it loses its fibrillar appearance and its power of staining deeply with special dyes. Fry used mucicarmine and was able to demonstrate the fact very conclusively. The cells of these tumors under the high power of the microscope are definitely epithelial (Fig. 2).

Although most pathologists believe in the epithelial nature of these tumors there are still some who cannot agree to classify all mixed tumors of the salivary gland under that heading.

Ewing considers that the endothelial origin of mixed tumors of the salivary gland has been entirely disproved but adds: "No in the source of the mixed tumors meets all the requirements. Some are distinctly adenomatous and probably arise from the acini and ducts of the gland in which they are well incorporated. Others are encapsulated or extraglandular and take the form of basal cell or adenocystic epithelioma. These probably arise from misplaced and occasionally embryonal portions of gland tissue. Branchial

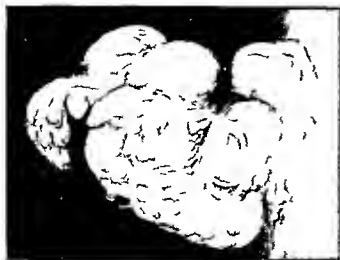


Fig 3 Mixed parotid tumor after excision

remnants may possibly be connected with this group. This conclusion from such an eminent authority may be said to represent the present state of our knowledge with regard to these tumors and I think that the term mixed tumors should still be used to designate them although the majority are certainly epithelial in nature.

Mixed parotid tumors are equally common in either sex and know no age incidence; they may occur in children or in old age.

These tumors are usually situated in the superficial portion of the parotid gland and are freely movable in the gland substance and are coarsely nodular (Fig 3) and vary in consistency in different parts. The facial nerve in its course through the parotid gland is deeply placed (Fig 4) and hence is not pressed on by these tumors unless they undergo malignant change. They have a definite capsule and outside this the gland tissue is somewhat compressed to form an extra pseudo capsule. This fact is important from the point of view of treatment. If excision is undertaken and the tumor is removed a parotid fistula rarely results; this is due to the fact that the compressed gland substance around the tumor prevents any escape of secretion.

These tumors show a definite tendency to recur even after a long interval and are therefore considered by many surgeons to be potentially malignant. Burrows considers that the most satisfactory method of treatment is operation combined with radium irradiation.

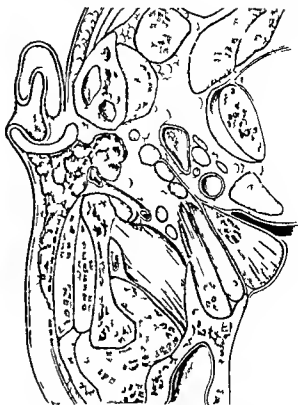


Fig 4 Coronal section through the parotid gland illustrating the course of the facial nerve

This may be so but great caution should be observed in radium treatment and small doses of radium only should be employed at operation. The radium tubes should be left in the cavity after removal of the tumor. I have seen two cases in which radium was employed and complete paralysis of the facial nerve ensued.

As a rule these so-called mixed tumors are of slow growth and frequently many years elapse before the patient seeks advice or will consent to operation. Rapid increase in size of the tumor or the onset of facial paralysis may be the determining factor which induces a patient to seek treatment. Unfortunately both these signs are usually consequent on malignant change.

During the years 1900-1925 52 cases of parotid tumor have been operated upon at King's College Hospital. In 40 cases the tumor was removed and on histological examination was found to be a mixed tumor while in 12 cases the tumor was found to be malignant.

Of the 12 cases of malignant disease of the parotid 7 occurred in men and 5 in women. The average age of the 12 patients was 58.



Fig. (left) M. d. p. t. l. t. m.
l. t. m. l. t. t. t. m. d. g. m. l. t.

year. The facial nerve was involved in every case and the average length of life after involvement of the facial nerve was 16 months. The longest was 3 years and the shortest 6 months.

Of the 40 cases of mixed tumor I have been able to trace only 35 cases. In 19 cases (54 per cent) there was a history of recurrence of the tumor which necessitated a further operation. In one case three subsequent operations were performed. In 5 cases death occurred within 10 years of the operation from malignant disease of the parotid. In 19 cases there has been no recurrence and the patients have remained in good health.

With regard to malignant disease of the parotid the treatment of radium or deep X-ray therapy does not seem to lengthen life to an appreciable extent.

Some of the early cases of malignant disease of the parotid were treated before the introduction of X-ray or radium while the later ones were given combined treatment.

McFarland quite recently reviewed the literature of 90 cases of parotid tumor. He came to the opinion that carcinoma



Fig. M. d. t. m. f. the l. m. t. l. y. l. l. f. j.
y. t. a. d. n. g. l. t. m. d. t. h. t. d. l. l. t. y.

very rarely develop in a mixed tumor and states that when such a change occurs its proof is very difficult on histological ground.

Stoehr and Risak analyzed 71 cases of tumor of the parotid which have been seen in Prof. Dr. Hochenegg's clinic for a period of 22 years. Of 59 cases of mixed parotid tumor radical removal was performed in 50 and of these 50 were traced. It was found that 3 had remained free from recurrence after one operation. In the remaining 7 cases recurrence took place up to 9 years later.

Whatever the pathogenesis of mixed tumors of the salivary glands may be it is quite certain that recurrence after operation is quite common and therefore these tumors should be considered as potentially malignant.

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A STUDY OF THE INJECTION TREATMENT FOR VARICOSE VEINS

LOUIS A. GILLESPIE, M.D., FACS, AND ROBERT L. MILLER, M.D., CHICAGO

THIS combined clinical and laboratory study of the injection treatment for varicose veins was undertaken for the purpose of evaluating the method in our own minds. The incidental appearance of some unusual complications has prompted us to submit the results of our study for publication.

The history and technique of the treatment have been described by Dunbar, Forester, Hanschell, K. Linser, P. Linser, McPheeters, Meyer, Sicard, and others. A variety of solutions has been employed, the more important of which are sodium chloride 15 to 25 per cent, dextrose or glucose 50 to 66 per cent, and quinine urethane consisting of quinine 4 grams, urethane 1 gram, and distilled water 30 cubic centimeters; mercuric cyanide 0.1 grams per cubic centimeter, metaphen (Schusler) calorse, mercury bichloride 1:5000 to 1:100 phenol 5 per cent, sodium citrate C.P. in distilled water as 8 grams, alcohol 30 per cent, tincture of iodine, and iodine in the form of Pregl's solution.

Each solution has acquired its exponents and its opponents. Sicard and Forester (7) have used sodium salicylate to good advantage, but Jorgensen reports a case of salicylate intoxication following an injection of 5 cubic centimeters of 20 per cent sodium salicylate. To avoid such reactions, Sicard advises a preliminary test dose of 1 cubic centimeter of the 5 per cent solution. Delater noted from the use of salicylates reactions of a vagotonic character about once in every 200 cases. These reactions consisted of cold sweats, the slowing of the pulse, nausea, and vomiting. The reactions from quinine were of a toxic nature consisting of itching and milium eruptions. Anaphylactic manifestations more common in women were also noted after quinine injections. Delater controlled the mild reactions by injections of epinephrine. Crampy pains, indolent sloughs, limitation of dosage, and toxicity of the compounds have constituted obstacles to the universal acceptance of the injection treatment for varicose veins.

However, when K. Linser in 1914 (15, 16) introduced the use of 15 per cent sodium chloride as a sclerosing substance, the attention of many men was attracted to the method. We have been using chemically pure sodium chloride in a 20 per cent concentration for the past year at the Michael Reese Hospital with interesting results. The solutions have been double autoclaved in spite of the statements by Linser (16) and Kottmayer that 15 per cent sodium chloride solution is sterile after 48 hours by virtue of its high concentration. The solution has proved very effective in the thick-walled veins of men. The existence of ulceration or *eczema cruris* has been no contraindication to its use. In fact, the best results have been obtained in this type of case. In the thin-walled vein of women with an abundant fat deposit in the subcutaneous tissues of the legs, on the other hand, difficulties have been encountered. Here the indolent and painful sloughs commonly described as complications of the technique occurred in two cases; one patient had two sloughs. Two were due to the extravascular injection of a small amount of the solution, but the third occurred following an injection that was definitely into the vein. When the latter slough was removed, bleeding resulted and recurred frequently.

The appearance of a slough due to an extravascular injection can easily be predicted since the patient complains of severe burning at the site of injection, and the area becomes white and insensitive to pain. Hanschell has recently described a type of slough occurring about 1 inch above the point of injection, in spite of an accurate injection into the vein. He directs the needle upward, and it is possible that the slough appears at the point where the stream of the injected fluid impinges against the wall of the vein. Such sloughs healed readily following the injection of hypotonic salt solution. We have recently been injecting hypotonic salt solution about the point of injection when immediately following the intravenous use of 20 per cent sodium chloride, a leak has

extra systoles were noted. The urine was negative January 10 1928. Fourteen hours after injection temperature was 98.2 respiration 18 pulse 96. Numerous extra systoles occurred at regular intervals. Sixteen hours after injection electrocardiogram (Fig. 1 C) discloses Sinus rhythm Rate 68 I R interval 0.16 second. The following differences between this curve and the one taken before the injection of the salt solution are noted: Increase in amplitude of R₃ notching of auricular wave in lead two and increase in amplitude in lead three. Shortening of I R interval by 0.02 to 0.04 second.

Twenty-one hours after injection pulse was 72 and regular. On January 18 1928 the ulcer was healed.

The explanation of this phenomenon is difficult. Howell says: "The sodium salts in the blood and lymph take the chief part in the maintenance of osmotic pressure. The sodium ions have in addition a specific influence on the state of the heart tissue. Contractility and irritability disappear when they are absent when present alone in physiological concentration in the medium bathing the heart muscle they produce relaxation of the muscle tissue. Whereas Starling says: 'It has been suggested that the rhythmic contractions of the heart muscle may be the result of constant chemical stimulus of the inorganic salts present in the blood plasma sodium acting as a stimulus to contraction while calcium salts are necessary for the maintenance of relaxation.' The exact significance of these different salts for the functions of cardiac and other forms of muscular tissue though they have been the subject of many detailed investigations must still be an open question. Dr W. S. Priest of the electrocardiographic laboratory of the Michael Reese Hospital has offered the suggestion that the change from normal rate to auricular flutter in this case might be the result of a change in the concentration of the electrolytes of the blood. He adds that since the most marked change is concerned with the auricle and since slight abnormalities were noted in the auricular waves of the control curve it seems possible that the effect obtained by the injection of the salt solution was based on its action on an already damaged tissue. The fact that the effect was not a specific reaction to sodium chloride was determined 2 weeks later January 4 1928 when curves were taken on the patient before and after 10

grams of sodium chloride diluted with two glasses of water were administered to the patient by mouth with the following results:

Before sodium chloride was given by mouth Sinus rhythm Rate 71 P R interval 0.20 seconds Inversion of T₃ P₃ is notched. Occasional ventricular ectopic beats a 1 mg from 1 to 100 c in the left and 1 one in the right ventricle. Two hours after 10 grams of sodium chloride was given by mouth Sinus rhythm Rate 65. Aside from the difference in the rate and the absence of ectopic beat the curve is the same as the previous one.

To determine the effect on concentrated salt solutions on normal hearts dogs were injected intravenously with 0 per cent sodium chloride 0 per cent potassium chloride and 10 per cent calcium chloride in 3 cubic centimeters 3 cubic centimeters and 2 cubic centimeters amounts respectively. Electrocardiograms were made before and after the injections with such negligible variations in the curves that we hesitate to attribute them to the introduction of the solutions since variations of such minor character are frequently found in dogs.

The lesson to be learned from the case reported is that patients of advanced years with a slight tendency to cardiac irregularity may be adversely affected by sodium chloride injections.

Another patient who had varicosities of all of the superficial veins of both legs but no evidence of involvement of the deep venous system complained of symptoms of intermittent claudication following treatment of his varicose veins. After walking about 50 feet he would experience cramps in the muscles of his legs and was unable to proceed for a period of a few minutes. These symptoms disappeared in the course of 6 months and he then experienced such difficulty only occasionally especially after he stood in one position for a long time. We feel that the rapid obliteration of the superficial venous system in this patient may have played some part in the appearance of his symptoms although these complaints were present to a minor degree before the injection treatment but were perhaps not given sufficient credence in our zeal to attribute them to the most obvious pathology the varicose veins.

Because of the reputed painlessness of the injections and the absence of sloughs following

extravascular leakage glucose solutions are now being used by many clinics. To test the relative merit of glucose and sodium chloride we did a series of injections on dogs with 20 per cent sodium chloride and 50 per cent glucose in commercially prepared ampules. We realized that in such experiments the dilatation and slow blood current of varicose veins would not be imitated. On the other hand Leard describes the greatest reaction from the sclerosing injections as occurring in the intima. According to the work of Berntsen the histology of varicose veins consists in most cases of an atrophy of the circular muscle of the media at first compensated by an hypertrophy of the elastic fibers but later followed by an atrophy of these fibers without notable effect on the intima. We therefore felt that a fair comparison of the relative effects of the two solutions could be made especially if the effect of stasis was partially imitated by injecting distalward and applying a pressure pad over the site of injection for 48 hours. Accordingly 4 veins were injected with 4 cubic centimeters of 20 per cent sodium chloride solution and removed consecutively 3, 3, 7 and 14 days after the date of injection and 5 veins were injected with 50 per cent glucose solution 4 cubic centimeters intravascularly and extravascularly in the first case and 5 cubic centimeters intravascularly in the 4 remaining cases. The second injection of sodium chloride was also made intravascularly and extravascularly for comparative purposes. When excised this vein was found surrounded by a dark area of hemorrhage whereas the extravascularly injected glucose vein which was removed 7 days after injection was merely embedded in fibrous tissue with no gross evidence of slough. The remaining glucose injected vein were removed 1, 17, 3 and 30 days respectively after the date of injection. Transverse sections were taken from three points of each vein and stained with hematoxylin and eosin and Weigert elastic tissue and van Gieson stains.

Only one of the veins injected with glucose was thrombosed. A section of that vein is shown in Figure 4. It was removed 17 days after injection and has a well organized and canalizing thrombus firmly attached to the

wall of the vein. The intima is entirely absent and the thrombus is attached to the inner layer of elastic fibers. A comparison of this photomicrograph with that of a section of vein removed 14 days after injection with sodium chloride solution (Fig. 3) discloses a somewhat better preservation of the elastic fibers in the former especially those adjacent to the thrombus. A comparison of both of these sections with that from a normal vein (Fig. 2) from the same dog as that from which the section of Figure 3 was removed demonstrates the effect on the elastic tissue of the media of the sclerosing injections in the 2 cases. The fibers lack the length and feathery distribution seen in the normal (Fig. 1). Both of the injected veins have an increase of fibrous tissue in the media. In the adventitia there is practically no change. From these sections one gains the impression that in addition to the intima the elastic tissue of the media also suffers as a result of the sclerosing injections. This finding was not present in all of the veins presenting changes but the possibility of its occurrence is well demonstrated by the photomicrographs submitted.

The sections of the veins injected with sodium chloride demonstrate a regular progression of the process of thrombosis from a hyaline clot with prominent lines of Zahn in the specimen removed 3 days after injection to beginning fibrosis in the specimen removed 7 days after injection and to well advanced organization and canalization in the specimen removed 14 days after injection. The intima in the earlier sections is almost completely absent the subendothelial tissues have a fairly heavy deposit of polymorphonuclear leucocytes the media contains a variable amount of elastic tissue and its muscle layers are cloudy. The adventitia has a marked accumulation of red blood cells and leucocytes. There is evidently an endophlebitis and periphlebitis with a less marked involvement of the muscular layer. The periphlebitis may be due either to the extension of the process through the entire wall of the vein or to the presence of the solution in the vasa vasorum. The elastic tissue of the adventitia in this case is practically unchanged. The same may be said for the elastic tissue of the adventitia of all of the other vein



Fig. 2. Portion of cross section of normal vein of dog showing elastic tissue of media, elastic tissue and lumen. Giemsa stain $\times 25$.



Fig. 3. Portion of cross section of vein from same dog as in Fig. 2, 4 days after injection with 50 percent humic acid. Elastic tissue and lumen. Giemsa stain $\times 25$.

injected. The elastic tissue of the media in these sections, however, is markedly fragmented.

In the sections taken from the vein removed 7 days after injection with sodium chloride the intima is almost entirely absent with a well formed thrombus filling almost the entire vein. The media appears somewhat disrupted with groups of red blood cells and leucocytes between the connective tissue and muscle cells, especially beneath the area of attachment of the thrombus. The elastic fibers are present in good amount and fairly well preserved except where the clumps of red blood cells and leucocytes are found. The adventitia contains a liberal sprinkling of small round cells and an occasional polymorphonuclear leucocyte.

In the sections taken from the vein removed 14 days after injection with sodium chloride (Fig. 3) a well organized thrombus undergoes canalization. Serial sections disclose a completely organized thrombus which is attached throughout its entire circumference at one point but lies free in the vein at other points. No intima is present in the section showing the complete attachment of the thrombus, but it is well preserved in the sections in

which the thrombus lies free in the lumen of the vein. The media contains many hemorrhagic areas. It is very fibrotic and contains some small round cells. The elastic tissue of the media is diminished in quantity and the fibers are thin and fragmented, especially where the groups of red blood cells are present. Areas of red blood cell accumulation are also present in the adventitia along with an occasional small round cell and polymorphonuclear leucocyte. The hemorrhage in the adventitia of the last case appears to be the result of trauma incident to the removal of the vein.

A microscopic study of the veins in which extravascular injections were made confirm the gross findings. The sodium chloride vein presents a diffuse hemorrhagic reaction with absence of the intima, a well formed clot in the lumen, infiltration of all of the layers with red blood cells and leucocytes in abundance and marked fragmentation of the elastic fibers of the media. The glucose vein has a small accumulation of red blood cells and leucocytes in the lumen, an almost normal appearing intima, a slightly cloudy media with elastic tissue fibers well distributed throughout, and an adventitia containing accumulations of leucocytes and small round cells loosely distributed



Fig. 4. The femur, showing the site of the injection of the sclerosing agent into the femoral vein.

about hemorrhagic areas. There is a mass of fibrin in the acute about the latter vein in contrast to the acute hemorrhagic inflammatory process about the former.

The findings are in agreement with those of Lohmann, who saw better results from the injection of 5 per cent sodium chloride than from the injection of hypertonic glucose solution. Doubtless too, as his experience with glucose has been on the whole disappointing, but occasionally astounding, good results have been obtained. Sir Sidney Alexander objects to the massive doses of glucose necessary to produce effective thrombosis. David Levi has felt that the looseness of the clot obtained in his studies after injecting 66 per cent glucose was contributory to the embolic results in one of his cases. Goldsmith in reply to Levi states that he prefers glucose solution because it produces non-toxic clots not producing local necrosis and can be sterilized by boiling for half an hour without the production of toxic substance. Forester and Davidson report to Levi, say, that at present it is an open question whether there is any difference between the thrombus produced by glucose and that produced by the other solution. He is further credited with saying, the

only fatal case reported in the literature followed the use of glucose. The last statement is probably incorrectly attributed to Forester, since in his last article (3) he mentions the two cases cited in the literature in which death occurred from embolism, namely that of Olson, who used caloric and salt solution and that of Homholt, who used a concentrated solution of sodium chloride. Meisen had two cases of small infarcts of the lung occur in his practice in connection with the treatment. At that time he was using concentrated sodium chloride but attributed the accidents to the use of 5 cubic centimeters of the solution. He refers to 5 cubic centimeters as an infarct giving dose. He has since changed his solution to sodium salicylate 25 per cent and sodium chloride 10 per cent equal parts and he limits the amount injected to 10 cubic centimeters. He adds, "It is noteworthy that the case of phlebitis and with infarction all had a very marked dilatation of the main trunk of the femur."

Our results confirm the statement that under ordinary circumstances glucose does not produce necrosis but is less reliable as a sclerosing agent than concentrated sodium chloride. The thrombus obtained from glucose injection certainly was firmly attached to the entire circumference of the vein as may be observed from Figure 4. It will probably prove to be a very valuable sclerosing agent in the thin vein of women with rather adipose legs, where from our present experience we feel that sodium chloride injections are accompanied by the hazard of periphlebitis and sloughing. It may also prove of advantage in cases of advanced years where cardiac irregularity and arteriosclerosis is a factor.

Meisen has recently added a few interesting contributions to the technique of the treatment. In cases in which the main trunk of the femur is injected he compresses the trunk at intervals by a pelotte held in place by a circular band of adhesive tape tightened down 1 centimeter below the skin level. A rule the phlebitis and thrombosis do not extend above the adhesive tape. However once in a great while it extends above the bandage, the strip of which leaves deep impression in the thrombus and thus anchors it. In delicate telangiect

tases which the patients wanted removed for cosmetic reasons he slit open the venule in two cases with a cataract knife and covered the wound with a compress moistened with the injection fluid. He prefers to insert the cannula in the vein with the patient standing with his weight on the limb whose veins are to be injected. He has found that the placing of the body weight on that leg increased the venous pressure in its varicose veins on an average of from 6 to 10 centimeters of water. The veins then stand out more clearly and are more easily entered after which the patient is allowed to lie down and the injection is made. We have utilized the latter principle by having our patients sit astride a dressing room table with the leg to be injected on a stool and the patient bearing heavily on that leg. The application of hot towels to the limb for a few minutes will often make the veins become more prominent. After the needle is inserted into the vein the patient may be changed to the horizontal position and the leg either elevated or kept on the level with the rest of the body without disturbing the position of the needle. Like Dunbar and others we have preferred to direct the point of the needle downward and start the series of injections as low down as possible. Compression is made over the site of injection by a pledget of gauze for about 3 or 4 hours. We have felt that this procedure prolongs the contact of the solution with the intima of the vein and insure a better reaction and to a greater degree limits the upward extent of the thrombus. Sicard has demonstrated by lipiodol injections into veins the passage of lipiodol into the deep veins on slight muscular movement. If there has been no deep thrombophlebitis and the injection fluid enters the normal veins Meisen believes that it is washed away by the circulating blood. Such is probably the case since practically no reference is made in the literature to deep thrombophlebitis as a complication of the treatment. One of our patients did complain of pain deep in the posterior portion of the thigh for a week following an injection into a vein on the anterior surface of the thigh. However there was no edema and local findings were so questionable that the diagnosis of deep thrombosis was doubtful.

SUMMARY

In experimental studies conducted on dogs with 50 per cent sodium chloride and 50 per cent glucose as sclerosing solutions for the obliteration of veins we found the sodium chloride solution to be more effective than glucose but more irritating when injected extravascularly. There was apparently no difference in the structure of the thrombi or their adherence to the wall of the vein although only one thrombus was obtained following glucose injection whereas thrombi developed uniformly following sodium chloride injection. When the irritative process extended through the entire thickness of the wall of the vein the elastic tissue of the media was especially liable to destruction. The effect on the elastic tissue was more marked in the veins injected with sodium chloride than in those injected with glucose.

The clinical technique and complications are discussed. A case of auricular flutter developing after the injection of 10 cubic centimeters of 20 per cent sodium chloride is reported.

After a comparison of the results obtained by operation with those obtained by the injection of sodium chloride solution in the treatment of varicose veins in men we feel that the injection treatment offers many advantages over operative treatment and yields as good if not better results than those obtained by operation. Our results from the use of sodium chloride in women have not been as satisfactory as those in men.

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THE PATHWAY FOR VISCERAL AFFERENT IMPULSES
WITHIN THE SPINAL CORDII EXPERIMENTAL DILATATION OF THE BILIARY DUCTS¹

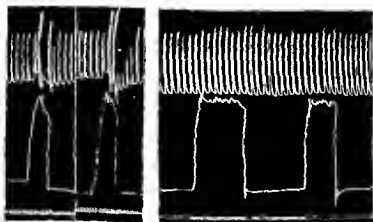
LOYAL DAVIS M.D. F.A.C.S. J. THAPT M.D. AND R. C. CRAIN M.D. CHICAGO

SOME years ago one of us (2) became interested in an attempt to determine the pathway for visceral afferent impulses within the spinal cord. In those experiments vasomotor, respiratory, and other evidences of pain were produced by faradic stimulation of the thoracic sympathetic trunk in cats. Various horizontal lesions were produced in the spinal cord in an effort to obliterate these responses. It was found that a transverse section of the cord was the only experimental lesion which would be followed by a cessation of the responses to stimulation. It was concluded that painful impulses from the viscera transmitted by the thoracic sympathetic trunk are conducted upward by relays of short spinal paths with synapses in the gray matter of the spinal cord. These results were different from those of Ranson, von Hess, and Billingsley (8, 9) who traced the pathway for somatic afferent impulses which were accompanied by similar vasomotor and respiratory effects. They stated that these impulses enter the spinal cord through the lateral division of the dorsal roots which consists of unmyelinated fibers and ascend in the tract of Lissauer near the apex of the posterior horn.

In addition to its academic importance, the knowledge of the location of the visceral afferent pathways within the spinal cord and of the manner in which they reach the spinal cord is of clinical interest. Stookey has presented clinical evidence which supports the view that this pathway is situated in a juxtaspinal position. He pointed out that in extradural spinal cord tumors, bladder and rectal disturbances are not present until compression of the cord is extreme. Schrage and Ivy have shown that dilatation of the cystic duct in the dog is accompanied by a marked inhibition of respiration, vomiting, struggling, and other evidences of pain. These responses could be abolished completely by section of

the right splanchnic nerve. Spiegel and Bernis found that the reactions which occurred after stimulation of the right splanchnic nerve were abolished only after destruction of the antero-lateral columns of white matter in the spinal cord. This would indicate a similar intraspinal course for visceral afferent impulses and those of pain and temperature sensation. However, the illustrations of their experimental lesions show an extensive destruction of the gray matter. Kappis and Neumann have stated that the viscera receive their sensory innervation in a segmental manner from the right and left splanchnic nerves. Laewen relieved patients with visceral pain by the injection of 1 per cent novocain solution into the lateral vertebral foramina. He obtained successful results which were of course brief, but von Gasa and Leriche used the same procedure as a preliminary therapeutic step. After they determined the level at which the pain could be relieved, they sectioned the rami communicantes and simultaneously removed the posterior root ganglia. Since then Seringer and Archibald have reported successful results after a similar procedure.

For many years surgeons have attempted rather empirically to relieve the pain of the gastric crises of tabes by posterior root sections and by anterolateral sections of the spinal cord, first suggested by Spiller and carried out by Martin. These operations have been followed by indifferent results. One of us recently has had a clinical experience in point. The posterior and anterior roots from the fourth dorsal to the twelfth dorsal were sectioned bilaterally in a patient with severe visceral crises. This procedure was carried out in two operations and inadvertently the eighth pair of spinal roots were left intact. Although the area of superficial cutaneous sensibility represented by this root was extremely small, the patient continued to have



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the crises unabated. It would appear that only a very small pathway to the spinal cord was sufficient to carry the impulse from this patient's visceral crises.

In the present experimental work we have concerned ourselves with a study of the spinal cord pathway for visceral pain initiated by the forceful dilatation of the cystic duct and biliary passages.

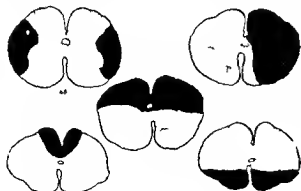
EXPERIMENTS

All of our experimental work was done upon dogs. We used 75 animals upon all of which an autopsy was performed. Each step in the problem was repeated several times because different dogs did not always react to the same stimuli in the same way and allowance must

be made for this fact. Our experiments may be said to fall into two groups: (a) those in which attention was directed to the right splanchnic nerve and (b) those in which attention was centered upon the spinal cord.

The former group of experiments consisted essentially of a repetition and verification of some of the evidence already shown by Schrager and Ivy. Our procedure in this group of experiments was as follows: The animal was prepared and anesthetized in the usual manner under strict aseptic technique. The abdomen was opened through a right rectus incision and a small glass cannula was inserted into the cystic duct through the gall bladder and ligated in place with linen. The common bile duct was then ligated just proximal to its duodenal junction and the abdomen was closed. The animal was allowed to recover from the anesthetic and 4 hours later was prepared for a kymographic tracing. Sterile water at 39 degrees C. was injected into the cannula tube and the reaction was noted. This always caused the dog to struggle and show other signs of discomfort; there was also marked inhibition of respiration at the beginning of the injection and frequently the animal became convulsed (nauseated) and vomited, especially if the pressure exerted was above 150 millimeter of mercury.

After the demonstration of the reaction described the animal was again anesthetized



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Fig. 3



Fig. 4

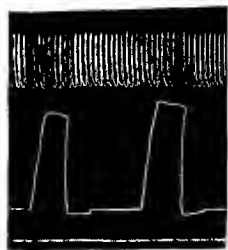


Fig. 5

Fig. 3 Tracing of an animal with a lateral hemisection of spinal cord Dog 59. Compare with section 59 shown in Figure 2.

Fig. 4 Tracing of an animal with a posterior section of the spinal cord Dog 62. Note the absence of inhibition

of respiration. Compare with section 62 shown in Figure 2.

Fig. 5 Tracing of an animal with an anterior hemisection showing the absence of inhibition of respirations Dog 41. Compare with section 41 Figure 2.

and the right splanchnic nerve was exposed through a right lumbar incision. A segment approximately 1 centimeter long was removed from the nerve. The wound was sutured and the animal was allowed to recover for a period of 4 hours. Then the kymographic tracing was repeated the same procedure as before being followed and the results noted. In no instance was there any evidence of pain or distress upon dilatation of the ducts. There was a partial diminution of respiratory inhibition but salivation and vomiting were observed as frequently as before the nerve was severed. These findings agree with the results obtained by Schragar and Ivy who showed that cutting the right splanchnic nerve abolishes all pain dependent upon dilatation of the cystic and biliary passages.

B. Experiments Centered upon the Spinal Cord

Inasmuch as we intended to interrupt if possible the spinal cord pathway of fibers from the right splanchnic nerve it was admittedly necessary to produce the cord lesion above the known exit of its fibers. The nerve arises from the sixth seventh eighth ninth

and sometimes the fifth and tenth thoracic segments. We therefore arbitrarily chose the second or third thoracic segment as the level at which all lesions would be made. Each animal was prepared and anesthetized in the usual manner and the strictest aseptic pre-

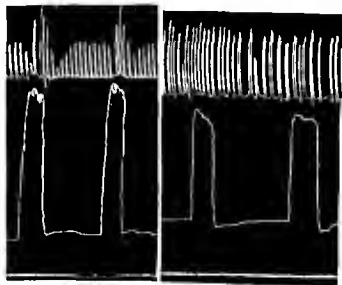
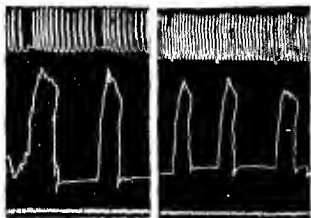


Fig. 6 (left) Tracing of an animal with an anterior section of the spinal cord showing inhibition of respirations Dog 60. Compare with section 60 Figure 2.

Fig. 7 Tracing of a dog with bilateral anterolateral section of the spinal cord showing inhibition of respirations Dog 66. Compare with section 66 Figure 2.



F. H. A. (1 ft) T. A. G. of Dog 43 h. S. H. B. T.
 f. j. t. p. o. n. d. l. t. t. o. n. f. t. h. e. y. t. d. t. B. s. m.
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cautions were taken. The spines of the upper three or four thoracic vertebrae were exposed and enough of the laminae removed to expose the cord for a distance of 3 centimeters. The dura was incised and the desired lesion made in the cord a Frazier chordotomy knife or a fine extract blade being used. The muscle and fascia were sutured with plain catgut. The skin was closed with dermal sutures and the animal was allowed to recover.

At least two weeks were allowed to elapse before the second operation in order to allow for degeneration of the cut fibers in the cord. By that time sufficient degeneration had taken place in columns affected by the lesion to show as such with the Marchi stain and most of our cords were stained by this method. The animal was then prepared for the second operation. With aseptic technique the abdomen was opened and a small cannula placed in the cystic duct through the gall bladder and ligated in place with linen. The common bile duct was then ligated just proximal to its duodenal junction and the abdomen was closed. When the animal had recovered from the anesthetic or later (4 to 24 hours) he was prepared for a kymographic tracing. Sterile water at 39 degrees C. was then injected into the cannula tube and the reaction noted. If the dog struggled, cried out or showed any distress whatever other than slight respiratory inhibition it was assumed he was in pain.

After the reaction had been recorded on the tracing the animal was prepared for autopsy and the spinal cord removed. Small segments at the level of the lesion as well as above and below were removed for Marchi staining.

This procedure step by step was repeated many times and various lesions were made in the spinal cord such as right and left hemisections posterior and anterior sections posterior hemisection and bilateral anterolateral sections. The cystic ducts of normal dogs were cannulated, the ducts dilated and the reaction noted and the same procedure was repeated upon the animals after a complete transverse section of the cord. In other animals the same procedure was carried out but instead of cutting the cord the dorsal roots of all the thoracic nerves were severed intradurally and the reaction noted upon dilatation of the cystic and biliary ducts.

Our observations may be briefly summarized as follows. Dilatation of the cystic and biliary ducts in dog causes pain inhibition of respiration and frequently nausea and vomiting. Dilatation of the e ducts after the cutting of the right splanchnic nerve abolishes the evidences of pain and diminishes the respiratory inhibition. It does not appreciably affect the frequency of nausea and vomiting. Lateral hemisections of the spinal cord at the level of the second or third thoracic segment have no effect upon the responses which accompany bile duct dilatation nor do posterior sections at the same level which destroy practically all of the cuneate and gracilis columns without extensive damage to the central gray matter. Posterior hemisections which destroy not only the posterior horns but also a portion of the central gray matter abolish the responses. Anterior sections which involve only the white matter or anterolateral sections limited to the white matter have no effect upon the responses. Complete transverse section of the cord at the level of the third thoracic segment abolishes all responses as does intradural rhizotomy of all of the thoracic posterior roots.

DISCUSSION

This evidence is corroborative of Davie's experiments in which an artificial stimulation

was used to simulate visceral afferent impulses. We feel that these experiments are as close an analogy as is possible to the mechanism of pain from the biliary tract in a patient. Secondly, we are able to offer corroboration of the experiments of Schrager and Ivy who traced the pathway through the right splanchnic nerve to the spinal cord.

However, we believe that the most practical suggestion which may result from this work concerns the operative procedures which may be aimed at the spinal cord for the relief of visceral pain. From our work it would appear illogical to perform anterolateral sections of the spinal cord for the relief of gastric crises unless the sections include a considerable destruction of the gray matter. This is quite in keeping with the indifferent results obtained after this operation for the relief of gastric crises and gives an explanation for those cases in which relief was obtained by a section which was deeper than usual.

It would appear that posterior root sections should produce relief in patients with visceral pain. From our clinical experience as well as from our experimental evidence it seems obvious that a much larger number of roots than is common must be sectioned. The short course of these fibers within the cord and their innumerable synapses and relays make it difficult to remove all of the pathways for the visceral afferent impulses without a rather extensive rhizotomy.

It must be remembered that these experiments in no way question the pathway for the transmission of pain of somatic origin within the spinal cord. For such conditions anterolateral chordotomy is an operation which will yield definite relief.

CONCLUSIONS

1. Afferent impulses which result from the forceful dilatation of the cystic and biliary ducts travel toward the spinal cord in the right splanchnic nerve.

Section of a sufficient number of thoracic posterior spinal roots will abolish all of the responses obtained by forceful dilatation of the biliary ducts.

3. The only lesions of the spinal cord other than complete transverse section which abol-

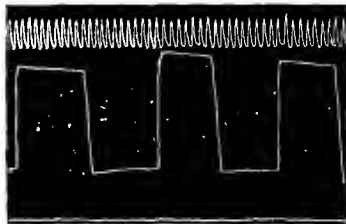


Fig. 9. Tracing of Dog 74 showing absence of inhibition of respirations after a bilateral posterior root section in the thoracic segments of the spinal cord.

ish these responses are those which involve a considerable portion of the central gray matter of the spinal cord.

4. Visceral afferent impulses are transmitted upward within the spinal cord by short fibers with many relays and synapses which have a juxtaganglionic position.

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STAB WOUNDS OF THE SPINAL CORD

REPORT OF SEVEN CASES

C. H. W. RAND, M.D., F.A.C.S., & GEORGE H. HATTISON, M.D., F.A.C.S., CALIF. SURG. A.

STAB wound of the spinal cord are of sufficient rarity to merit recording. Only six instances have been observed at the Los Angeles General Hospital since March 15, 1911, in a series of over one hundred and seven thousand cases. The interest of one of us (C. H. W. R.) was first drawn to the subject in the summer of 1913, when a policeman suffering from a recent stab wound of the cord was admitted to a large Chicago Hospital. The injury had been sustained but a few minutes before admission and was occasioned by his being stabbed in the back with an ice pick. The external wound was merely a small puncture which would almost escape casual observation. However, he showed evidence of complete interruption of the spinal cord at the level of the injury, which was in the upper thoracic region. In a few weeks the picture changed from one of complete cord lesion to that of a typical Brown Sequard type and then remained stationary. During his stay in the hospital many discussions were held as to the advisability of exploring the cord. This was finally deemed inexpedient. An attempt to secure the original record has been unsuccessful and the case can only be referred to in passing.

The rarity of the condition was recognized at the time and since then has been more emphasized upon us. It is difficult to produce manually because of the exceptional bony protection which nature has placed about the cord. Severe back injuries accompanied by spinal cord injury are common and constantly increasing in number. Automobile accidents, injuries incurred in the building trades and gunshot wounds account for the great majority. The etiology will not be considered, however, as the mechanism of their production is essentially different from that of a true stab wound of the spinal cord.

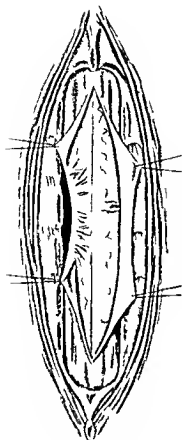
One is impressed by the fact that the large majority of stab wound cases have been reported by French and German observers and

that very few are reported by English or American writers. The latter half of the 19th century reveals the greatest number of reported cases. One is again reminded that in conjunction with animal experimentation much knowledge of the conduction pathways of the spinal cord has been gained in the past from a correlation of the physical findings with post mortem studies of the spinal cord in victims of stabbing frays. One reads again of the controversy which was waged a generation or more ago on the question of regeneration of the spinal cord marrow.

In the great majority of stabbing cases the injury to the spinal cord is purely accidental. One could almost never deliberately pierce a spinal cord with a sharp instrument. The majority of cases are the results of fights or brawl in which the blow is dealt haphazardly being usually aimed at the throat, neck or chest. A sharp pointed instrument is the rule most commonly a knife. Other implements however have been recorded such as a dagger, set stiletto, sword, scythe, sickle, file and razor, shoemaker's knife, gimlet, hat pin, ice pick, bayonet, etc. The blow is usually struck with a full swing of the hand and arm. It is accompanied by little if any pain. Several of the patients who have been under observation have been questioned with this point in view and all have remarked that "it didn't hurt." They knew they had been knocked down and immediately found that they could not get up again and walk. Sometimes one leg was paralyzed and numb but more often both were involved depending upon the extent of cord damage. We report a case in 1831 in which a Drummer of the National Guard of France threw his sword at a comrade striking him in the back of the neck thus causing immediate paralysis of the right arm and leg, with preservation of function of the left. Doubtless others have suffered similar lesions as a result of being struck by some hand thrown weapon. The edge of the broad sword and lance could doubtless

have furnished many examples of penetrating wounds of the spinal cord were records available. Gribbon reports a case of attempted suicide in a man who inflicted a puncture wound in the nape of his own neck. It is stated that the membranes of the cord were ruptured resulting in a cerebrospinal fluid leak and the patient succumbed on the eighteenth day from meningitis. The right hand presumably the one with which he struck, went numb immediately after the blow. That a cerebrospinal fluid leak may not follow immediately is shown by Vorster's case in which it appeared on the eighth day and closed on the sixteenth day following injury.

The majority of wounds are in the cervical or upper thoracic regions. This is partly due to the fact that these regions come within the natural sweep of the arm and partly because the blow is aimed at the neck or chest. Wagner and Stolper in their admirable collection of 81 cases from the literature found 59 to be cervical and 4 upper thoracic and Petron's table of 93 cases which includes some of the former found 43 cervical and 50 thoracic. Of the thoracic cases only 11 were struck below the sixth dorsal vertebra. The blow may fall at the base of the skull and penetrate the spinal canal between the occiput and the atlas. Staub and Weiss report such cases the cervical cord being severed or hemisected and the result being fatal. Kuehl's case did not die and Hofmann's was followed by immediate paralysis which later cleared up. He concluded that in all probability the paralysis was due to hemorrhage into the canal and that the cord was not cut. Courtin reports a fatal case in which the stab wound went through the arch of the atlas and another instance of penetration of the canal in which in a negro encounter a deep gash wound was inflicted by means of a razor. The point of the knife may not infrequently become broken off and left in the canal or wedged into the surrounding bony structures. Cuvillier Vogt, W. Mueller, Churcot, Owen and I've mention such cases. Rodriguez reports an instance in which the broken fragment pierced the canal and remained there for 28 years. Death finally occurred from nephritis. Autopsy showed a



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without damage to the cord itself as probably occurred in Cavillier's case a soldier who was stabbed at the twelfth dorsal vertebra and thereafter walked some 80 miles. The point of the knife was broken off in the canal. Again the cord may be irreparably damaged even when the dura is not penetrated. Intra-medullary hemorrhage probably occurs in the majority of cases in which the cord has been penetrated. It is associated with oedema. Hemorrhage into the canal is usually present and may be large enough to cause pressure symptoms. Later, after its absorption adhesions and thickening of the surrounding envelopes. Degenerative changes in the cord always follow penetrating wounds the type, direction and degree of degeneration depending upon the tracts injured. It is not necessary

to discuss the possibility of regenerative cord changes a subject which was warmly discussed in cases of cord injury a generation ago. Would that regeneration might occur! Oedema always takes place to some extent and may account for the fact that the initial symptoms following a stab wound of the cord are more extensive immediately following the injury than later on. Acute swelling prohibits the function of intact fiber tracts which may recover as oedema subsides. It was perhaps this fact that gave fuel to the heated discussion of the degree of recoverability of an injured cord. After a period of time gliosis and fibrous changes set in and decided thickening of the surrounding membranes follows. In our second case such changes were found 5 months after the injury. Cerebrospinal fluid leaks have been mentioned and are to be feared. That they are not more common is due to the fact that the inflicting instrument is narrow and the muscles contract after the weapon is withdrawn thus effectually closing the tract. Infection however may follow such a leak or even in its absence may give rise to meningitis.

Symptoms of paralysis occur immediately after the injury if the cord is penetrated. They may be delayed in cases of simple hemorrhage into the canal. Little or no pain is experienced in the majority of cases an argument against the so-called sensibility of the dura. In none of the cases we have observed has pain been experienced. Root pains however may be seen and cases have been mentioned associated with sharp pain encircling the chest, abdomen or radiating to an extremity. Tearing pains in the legs have been mentioned. There may be local tenderness of the soft tissue at the site of injury and crepitus of a broken spine on occasion may be felt. The symptoms of sensory and motor paralysis vary according to the level and extent of the cord damage. The majority of cases resolve themselves into the mixed or Brown-Sequard type. We have seen a flaccid paralysis of the extremities change to a spastic condition in a short time and later clear up. Bladder symptoms are common often retention at first later passing over to an incontinent or automatic type of bladder control. It is our impression

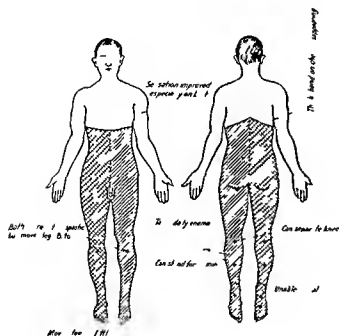


Fig 3 Case 2 Diagrammatic chart of findings 3 months after operation

that the majority of cases become ambulatory with more or less residual symptoms depending on the severity of the cord injury.

There is a relatively low initial mortality. Probably meningitis is the principal cause of death although general marasmus, decubitus and genito urinary infections are factors to be considered in all cases. Thorburn reported 40 cases with 15 deaths 9 of which were due to meningitis. The mortality is greater in the cases of high cord lesions and decreases as one goes down the canal. Roesler reported 46 cases with a cervical mortality of 40 per cent and a thoracic mortality of 31 per cent. Mortality in stab wounds between the first and second cervical was 71 per cent, at the fourth 53 per cent and at the fifth sixth and seventh levels 23 per cent. Frazier has combined the mortality of the series of Wagner and Stolper and of Enderlen comprising 148 cases with the following results —

| | |
|--------------------|-----|
| Wagner and Stolper | C |
| Enderlen | 9 |
| Total | 67 |
| | 148 |

| | | |
|-----------------------|---|----|
| Complete recovery | P | 14 |
| Permanent improvement | t | 65 |
| Death | | 2 |

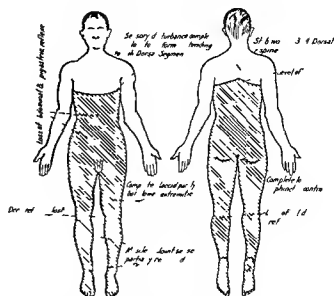


Fig 4 Case 4 Diagrammatic chart of findings before operation

We believe that all cases of stab wound of the cord do not demand operation. One must be guided by the patient's condition, the level of the lesion, the degree of apparent cord damage, the presence or absence of a cerebrospinal leak, etc. Roentgenograms should be made in all cases to ascertain whether or not a foreign body has been broken off, as well as to determine whether there has been bony injury to the spines or laminae. Small fragments of bone may be driven into the canal and not show in a roentgenogram. We have had this experience in one case. However, fractures or large indriven fragments should be seen. We believe a lumbar puncture should be done in all cases to determine the amount of free blood which may be present in the subdural space. Queckenstedt's procedure will give evidence as to the presence or absence of a spinal block. The wound should not be probed and should be treated aseptically. If laminectomy is not done, we believe the stab wound should be closed. Any indriven bone fragments or broken pieces of metal should be removed. Subdural hemorrhages should be relieved. Cerebrospinal leak usually calls for exploratory laminectomy. We believe that opening the dura in the majority of cases relieves edema to a certain extent and adds to the degree of recoverability of the cord. There are certain late cases in which improvement has come to a standstill that can be helped by removal of

lesion. Bladder and rectal control were lost. Priapism as present at times (Fig. 4). He had a temperature of 103 degrees a few hours after admission dropping to 99 degrees thereafter. X-ray examination of the upper dorsal spine revealed no fractures. Blood and spinal fluid Wassermann tests were negative. It was not stated whether there was free blood in the spinal fluid.

On June 10, 1915, a laminectomy was done. Spinal processes of the second, third and fourth vertebrae were removed. The second and third were found fractured at the base. The line of the stab wound could be followed directly into the spinal canal where it entered the dura on the left side and pierced the cord in the left dorsal column. At the point of intersection into the cord the wound measured approximately 2 by 3 millimeters in diameter and did not penetrate the substance of the cord more than 3 millimeters. The cord was otherwise swollen and hemorrhagic. No free blood was found in the subdural spaces.

Following operation the patient developed a large sacral bed sore and trophic ulcers on both heels which subsequently healed. He remained completely paraplegic until September 1, 1925, three months after his injury when it was noticed that there was slight movement in the right lower extremity. On September 8, 1925, he was able to move both legs slightly, and by September 25, 1915, could use both knees. From that time on his improvement was gradual but steady and by September 18, 1925, although very spastic he was able to walk with the aid of a cane. Sensation for touch, pain and temperature had entirely returned. The clonus was bilateral ankle clonus and Babinski, and at times involuntary twitching of the extremities. The deep reflexes were greatly exaggerated and about equal (Fig. 5).

CASE 5. Stab wound of the back between the spines of the second and third vertebrae. Flaccid paralysis of right lower extremity, no sensory disturbances noted. Cord not explored. Gradual return of power in right leg.

A 36-year-old male admitted to the Los Angeles General Hospital on October 25, 1925, complaining of paralysis of the right lower extremity. A short time prior to admission the patient got into an argument with some acquaintances and was stabbed in the back. He was intoxicated at the time and does not remember much of what occurred. Examination on October 26, 1925, revealed a man of 36 who looked the worse for wear, both eyes were closed and anisocoric. There was a stab wound in the midline between the second and third dorsal spines, also another stab wound on the left elbow. The right lower extremity was completely paralyzed and flaccid. The left lower extremity could be moved normally. No objective sensory changes were made out, although one would expect impairment on the right side. The right knee jerk and Achilles tendon jerks were gone. Left present. No Babinski or ankle clonus was present. X-rays of the upper dorsal spine failed

to reveal a fracture in the region of the stab wound. The case was considered one of a stab wound of the cord without much penetration of the latter structure.

On November 2, 1915, one week later patient began to move the right lower extremity. He regained the strength of the leg rapidly, although the flexors remained weaker than the extensors. The patient was not operated upon.

CASE 6. Stab wound of the back between the first and second thoracic spines. Brown Sequard's syndrome with paralysis of the right leg and numbness of the left immediately following. Exploration of the cord revealed a stab wound of the right posterior column, gradual improvement in all symptoms.

W. J. male, aged 39 years, single, negro, rancher. No. 54408 was admitted to the Los Angeles General Hospital on September 12, 1916. About 8:00 o'clock on the previous evening he was stabbed in the back and immediately afterward found that he could not use his right leg and that his left leg felt dead although he could move it. He stated that he suffered no pain at the time he was struck.

Examination revealed a young adult in good physical condition. There was a stab wound about 3 millimeters in length between the first and second thoracic spine from which fluid was draining. There was practically complete paralysis of the right lower extremity, the left could be moved normally. On the left side there was diminution of all forms of sensation, ending quite abruptly at the level of the third thoracic segment. There was also slight diminution of sensation on the right side ending at the same segment (Fig. 6). X-ray examination of the dorsal spine failed to reveal a fracture. The blood Wassermann was negative.

On September 4, 1916, a laminectomy was performed, the spines of the first, second and third dorsal vertebrae being removed. The stab wound could be followed from the surface directly into the spinal canal. It penetrated the dura near the midline and entered the cord in the right lateral column posteriorly (Fig. 7). The cut was in a longitudinal direction and measured only about 1.5 millimeters at the point of entrance to the cord. It was estimated that it did not penetrate the cord more than 1 to 2 millimeters. The surrounding cord was somewhat swollen and edematous but no spinal fluid was found in the canal.

On the following day the patient's temperature rose to 104 degrees, the neck became moderately rigid and a suggestive Kernig sign was present. The sides. Two days later these symptoms began to clear up and by the fourth day his temperature was normal and these signs of meningitis had disappeared. On September 1, 1916, one week after operation there was a noticeable return of sensation on the left side and a slight knee jerk was obtained on the right. On September 23, 1916, he began moving the right lower extremity slightly and by the 25th he could flex and extend the knee and adduct the thigh (Fig. 8). From this time on

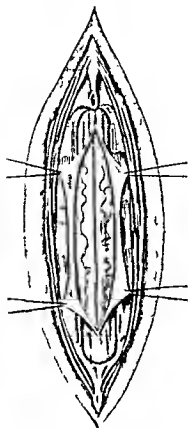


Fig 7

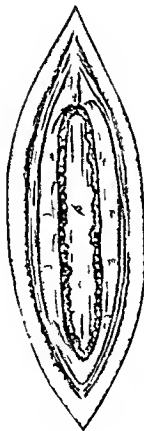


Fig 10

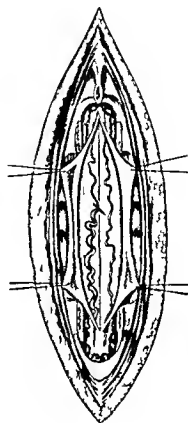


Fig 11

Fig 7 Case 6 Sketch showing small stab wound in the right dorsal column. Symptoms of fairly typical Brown-Sequard syndrome following injury. Recovery almost complete.

Fig 10 Case 7 Sketch showing findings when dura was opened. A large extradural clot was present and a dilated vein knuckled through the stab wound in the dura.

Fig 11 Case 7 Dura opened. The stab wound penetrates the cord at practically the midline. The left vein is dilated. Cord very oedematous and swollen.

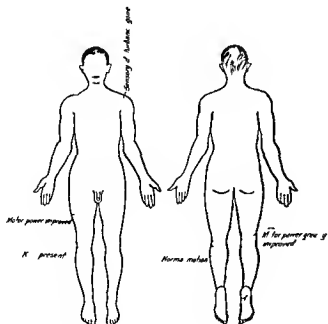


Fig 8 Case 6 Chart showing almost complete recovery 2 weeks after laminectomy.

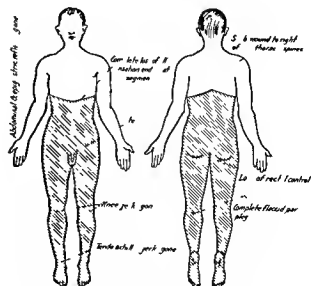


Fig 9 Case 7 Diagram showing findings of a complete cord lesion following stab wound.

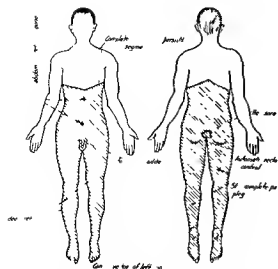


Fig. 1. Stab wound of the back. The wound was located on the left side of the back, 5 centimeters below the sixth thoracic spine. The wound was 1.48 centimeters long and 0.48 centimeters wide. The wound was closed with 10 sutures. No spinal fluid came from the wound. The muscles of the back on the right side were considerably swollen and tender. The patient presented the picture of a complete cord lesion with a sensory level ending abruptly at about the eighth dorsal cord segment. There was complete anesthesia to touch, pain, temperature, muscle joint and vibratory sense corresponding with this level. There was a loss of all superficial and deep reflexes below this level. Marked paraplegism developed and remained for about 5 hours. The patient was complete retention of urine and considerable bloating (Fig. 9). The blood Wassermann was negative. A lumbar puncture carried out on April 4, 1928, revealed a bloody spinal fluid under 75 millimeter pressure. Queckenstedt test showed a

partial block. When jugular compression was applied for 10 seconds the spinal fluid rose approximately 75 millimeters but it did not come back to the original level for 3 minutes and 15 seconds. A second test again showed a rise of 75 millimeters in the fluid in 10 seconds which did not return to the original level for over 3 minutes. Spinal fluid showed red blood cells 400, globulin increased, sugar normal, polymorphonuclear leucocytes 26. X-ray of the spine revealed no fracture or foreign body.

On April 4, the patient was still completely paraplegic with a loss of abdominal, epigastric and cremasteric reflexes as well as of all deep reflexes below the level of the lesion. There was no over a moderate plantar flexion of the toes of both feet in carrying out Babinski's test. There was further more a slight return of muscle joint and vibratory sense on the left side but not on the right. His temperature on admission was 101 degrees, pulse 20 respirations 40, red blood cells 4,000,000, white blood cells 12,500.

On April 25, 1928, there was no improvement from the preceding day. An exploratory laminectomy was carried out on April 26, 1928. No bony injury to any spines or laminae was encountered. After removal of the fifth, sixth and seventh spinal processes, the tissues between the fifth and sixth laminae were found to be bluish and bulging. Removal of the laminae revealed the space occupied by epidural fat and areolar tissue to be of purplish color. This entire space was filled with a blood clot. The dura seemed compressed forward in the canal and upon the exposure of this membrane the puncture wound was seen. This puncture wound took the form of a minute three-cornered tear. It measured approximately 3 millimeters in the long diameter which ran parallel with the cord and about 1 to 2 millimeters across. A large pial vein pushed up into the slight rent made by the dural defect (Fig. 2).

When the dura was opened the cord was found to be edematous and swollen particularly below the point of injury. The stab wound of the cord was in approximately the midline posteriorly and took a slightly diagonal direction. It was about 3 millimeters across and a probe could be gently introduced about 1 millimeter into its depth. The edges of this wound gaped slightly. On the left side the posterior pial vein was considerably enlarged and more to the right (Fig. 3). There was no free blood in the subdural space. There was no appreciable enlargement of the vessel above the stab wound. The dura was closed so that it could be done without unduly compressing the cord.

On May 3, 1928, it was noted there was much blood and pus in the urine. Both the large trochanteric ulcer was present over the sacral area and on the heels. The patient was somewhat critical course but by July 13, 1928, the bladder cleared up to a great degree and the bed sores were improving. Good light treatment and balsam of Peru dressings. At this time the sensory level was the same and

there was no motion of either extremity except that of the toes of the left foot which could be moved slightly. By August 12 1908 the patient could lift himself with the aid of a handle bar which was suspended above his bed and the trophic ulcers were healing. No change in sensory level was apparent (Fig 12). At this time patient was transferred to the Country Farm for further treatment.

SUMMARY

Stab wounds penetrating the spinal cord are not infrequently seen in large emergency hospitals. The initial symptoms are often those of a complete cord lesion. In the majority of cases these symptoms change as time passes usually becoming Brown Sequard in type. The degree of recovery varies depending largely upon the extent of original cord injury.

Laminectomy is indicated when a foreign body or bone fragments are present in the spinal canal. Lumbar puncture with Queckenstedt's test should be carried out to determine whether there is free blood in the spinal fluid or whether a block exists. Exploration will depend largely upon these findings. Cerebrospinal fluid leaks occasionally are seen and should be closed.

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THE MECHANISM OF PYELOVENOUS BACKFLOW

ITS CLINICAL SIGNIFICANCE

HERBERT F. TRAUT, M.D., BALTIMORE, MARYLAND

F. m. h. Depa. m. t. f. Cyn. l. gy. f. th. J. h. H. pl. H. p. l. d. U. y.

IN recent years much has been written concerning a phenomenon which has come to be known as pyelovenous backflow. Attention was probably first attracted to it by the appearance of radial shadows in X-ray pyelograms extending outward from the kidney calyces into the parenchyma. Writers called attention to it and very correctly cautioned urologists against the use of abnormal pressures in injecting opaque solutions into the kidney pelvis for they felt that the appearance of the peculiar shadows was due to extravasation of the fluid from the kidney pelvis outward into the substance of the kidney.

More recently the experimental production of these shadows in human and animal kidneys has been accomplished and studies have been made in an attempt to establish the mechanism whereby such shadows occur as well as the probable meaning of them. Two workers (1) who sought to produce the phenomenon and who used live animals for their experiment were unable to find any evidence that backflow had occurred in any of their specimens. But others (2) have been more successful and have produced shadows in the kidneys of different kinds of animals as well as in the human. In fact they were able to produce the shadows in 78 per cent of all kidneys of various types and in 88 per cent of all human kidneys injected. In human kidneys pressures of 70 millimeters of mercury or less were required (3). Inasmuch as the kidney is known to produce secretory pressures up to 100 millimeters of mercury when its outlet is completely and suddenly obliterated the results at once engage the attention of every one interested in urologic pathology. They seem to demand further explanation as regards their meaning and their bearing on renal physiology.

The explanation have been offered by several of those who accept the phenomenon

as occurring within the physiological limits of the human kidney although the exact mechanism has not been conclusively demonstrated by them. The consensus of opinion seems to be that pyelovenous backflow is a safety valve mechanism whereby the kidney is saved from pressure atrophy when its normal excretory channel becomes blocked sufficiently to raise intrapelvic pressure to a dangerous degree. This is accomplished they feel by opening up hitherto closed channels leading from the pelvis directly into the venous bloodstream thus draining the urine into the renal veins and reducing a pressure which might cause harm if constant for any considerable period of time. This explanation at once challenges interest for it has no known analogue in human physiology.

It seems important therefore that the mechanism of pyelovenous backflow be studied further and that its relation to the economy of the kidney be ascertained. But first of all its occurrence in the human kidney within physiological limits of pressure must be established.

A study of the human kidney has been carried out with the points in mind. The experiments have been made as carefully as possible in the hope that they might demonstrate the mechanism of pyelovenous backflow as well as its incidence and something of its relation to the normal kidney and renal physiology.

MATERIALS

Human kidneys removed at autopsy were used throughout the study. The time of death of the subject was ascertained in each case so that the comparative degree of autolysis could be known. At death the bodies were placed in a modern dry refrigerated room. As soon as the kidney was removed from the body the experiment was made. As will be seen in the protocol the kidneys ranged in postmortem age from 1 to 48 hours.

Only such kidneys as appeared to be normal in the gross were used

TECHNIQUE

The kidneys were placed in normal saline solution in an incubator at 37 degrees C for 1 hour to bring them to body temperature. The vascular channels were then washed out with normal saline solution injected at normal blood pressure through the renal artery—the object being to remove all possible obstacles on the venous side to backflow. The injection apparatus was then disconnected from the renal artery and secured firmly to the ureter. A mercury manometer was connected in series the precaution being taken to have it on the same level as that occupied by the kidney. The ureter and pelvis of the kidney were then injected with one or other of two masses. One mass was composed of 5 per cent neutral gelatin made up in Locke's solution and colored with India ink. The other was 10 per cent India ink diluted with Locke's solution. Both masses were maintained at body temperature. The gelatin mass seemed to be open to criticism because its viscosity was much greater than that of urine and might not therefore inject channels or spaces as easily or as completely as the latter. However it possessed the advantage that wherever it penetrated it could be fixed by chilling and the action of formalin. For this reason it was used with the India ink Locke solution as a control. As may be seen by examination of the protocol no practical difference seemed to exist between them. One mass seemed to produce the phenomenon as frequently as the other and the extent of the vascular tree occupied by the masses seemed to be analogous. However the gelatin gave much more clearly defined injections for examination under the binocular microscope.

The pressures were applied for periods of 15 minutes each commencing at 20 millimeters of mercury and progressing in 20 millimeter jumps. This was continued until the mass flowed freely from the renal vein or if this did not occur until the periphery of the cortex showed clearly that there was extensive injection of the small veins be-



Fig. 1. An X-ray photograph showing injection of the veins by the opaque solution. This occurred in a patient who had had a perinephritic abscess and had hydronephrosis and hydro ureter on the opposite side at the time the picture was made.

neath it or until such a pressure had been reached and maintained for such a time that it was obvious that there was to be no backflow.

The ureter was ligated before the pressure was released and the kidney placed in cold 20 per cent formalin. The kidney was fixed in the gross so that particularly in the case of the gelatin mass there would be no opportunity for further extension extravasation or blurring of the tissues by the wiping of the knife blade as it passed through them. The kidney was then cut in several directions so that a section was made from the cortex to the papilla through each pyramid. Tissues were taken from each pyramid showing injection and were prepared for study in three ways. One set of sections was dehydrated imbedded in paraffin cut in thin serial sections and stained with hematoxylin and eosin. This series served as a control for

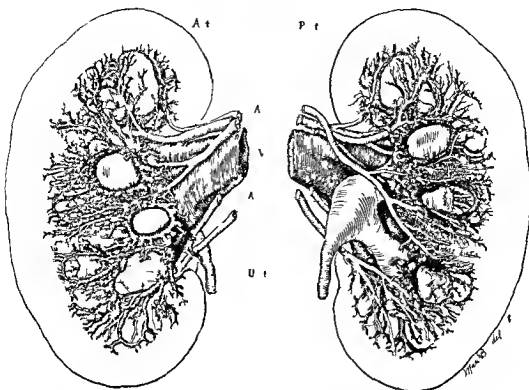


Fig. The t. d. p. t. e. of a. M. f. th. t. e. l. b. t. d. m. i. t. o. spe. me. f. the. hum. k. d. v. e. h. m. l. S. m. f. th. l. l. p. h. l. th. gl. ppl. d.

possible pathological conditions not seen in the gross specimen—a very important step as will be appreciated later. Another set of sections consisting of thin slices which were arranged serially and were made through one half of the pyramid was dehydrated and cleared in benzol and methyl salicylate according to the method of Spalteholz. A third series of sections was macerated in 75 per cent hydrochloric acid for microscopic dissection. A series of 36 human kidneys was prepared in this manner.

The material thus prepared proved satisfactory for the purpose in mind for in the cleared specimens the extent and position of the injection mass could be seen with the greatest clearness. The macerated material made possible the clearing up of certain points by actual dissection where the thinness of the cleared sections prevented their absolute demonstration such as the continuity of vessels, the relation of pelvic vein to peripelvic fat, etc. The stained serial sections

were helpful in demonstrating the presence or absence of pathological lesions, the degree of autolysis present, and the location of tears in the veins.

ANATOMICAL CONSIDERATIONS

To understand properly the mechanism of pyelovenous backflow, an accurate conception of the anatomy of the region about the tip of the renal calyx is essential. A knowledge of the course of the renal veins is particularly important. A number of years ago Mr. Max Brodel made an exhaustive study of the circulation of the kidney. By means of many injection corrosion specimens and beautiful drawings he demonstrated the vascular anatomy of the kidney most completely and satisfactorily. (6) Mr. Brodel very kindly allowed me the use of his corrosion injection preparations which are as beautiful today as when he made them originally in 1899. I wish to take this opportunity to thank Mr. Brodel for his drawings.

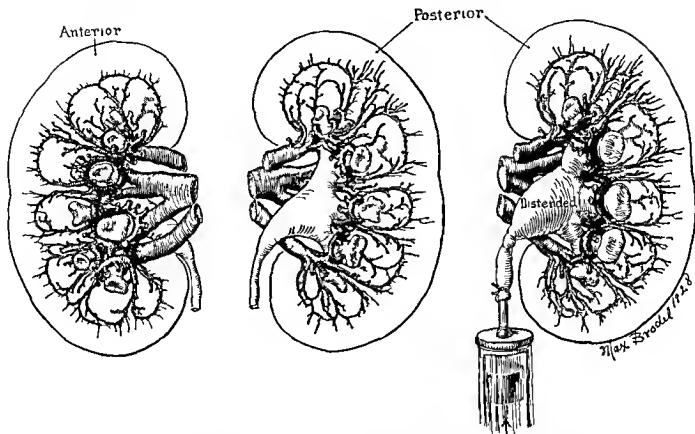


Fig 3 A simplified drawing demonstrating the inner and outer anastomotic venous circulation of the kidney. The relation of the inner venous collars to the minor calyces is shown with the pelvis undistended and distended.

which illustrate this study the use of his many beautiful injection preparations and for his helpful criticism during the progress of the work.

Instead of commencing with the stellate veins of the cortex and the venula recta of the medulla and progressing toward the large renal veins as is customary and logical in descriptions of the venous circulation we will proceed in the opposite direction because in considering pyelovenous backflow we are dealing with a retrograde process. The renal vein divides into several large branches which lie in various planes about the renal pelvis. These in turn again divide into two groups of major vessels. One group passes through the fat filled sinus renalis into the columns of Bertini and courses corticalward to the junction of the medulla and cortex. Here it anastomoses with its fellows to form the arcuate veins. The other group remains in the sinus renalis and anastomoses with its analogue which has usually passed to the other side of a minor calyx. Thus there are

two major systems of venous anastomosis: an outer one and an inner one. The outer system drains the stellate and intralobular veins of the cortex and the venae rectae of the medulla. The inner system supplies a shunt between the branches forming the outer anastomotic system. In a large proportion of the cases the inner anastomosis forms a venous collar if it is complete or a venous loop if it is not complete about the neck of the calyx. In the anterior group of calyces the veins nearly always form the complete venous ring about the fornix of the calyx. About the posterior calyces the venous anastomosis sometimes takes the form of a complete collar but more frequently is incomplete and forms only a loop (Fig 2).

The inner venous anastomotic ring or loop lies in the peripelvic fat of the sinus renalis and forms a collar about the neck of the calyx at a point usually just below the level occupied by the tip of the papilla so that the sharply angulated tips of the fornices of the calyces lie well above and within its circle.

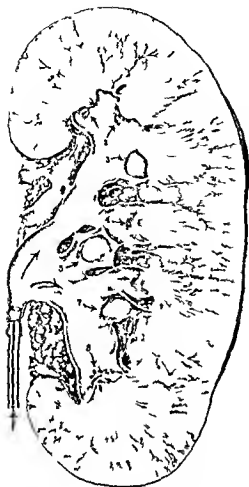


Fig. 4. O h l f f h u m a n k i d s w h h p y l n
 l k l h t k p l c T h e r p i f r p t u
 t l f f s m c i T h j e t f t h
 r a t d t l t u t h T h t
 d t t n f t h k n t t h e f t f t h u a l q t e

A comprehension of this relation is fundamental to an understanding of the mechanism of pyelovenous backflow and is therefore shown from several points of view in figures 3, 5 and 6.

THE MECHANISM OF PYELOVENOUS BACKFLOW

When the renal pelvis becomes distended all portions may expand excepting that which is reflected over the papilla for the reason that the whole pelvis is surrounded by a resilient medium principally areolar tissue filled with fat which allows it to give way to

internal pressures with the exception of that area represented by the papilla. This area is supported by fairly compact tissue composed of collecting ducts surrounded by connective tissue. Therefore when the pelvis dilates the sharply angulated fornices of the calyx round out becoming more obtuse or arcuate in shape (Fig. 7). If dilatation is carried far enough rupture occurs. Such rupture is found uniformly at the tip of the fornix where the tissues surrounding the pelvis change from those which are elastic to those more or less dense and less yielding. An accessory factor predisposing to rupture at the fornix of the calyx is probably the course of the connective tissue fibers in the wall of the pelvis. At the fornix they divide to form a T, a few fibers being reflected onto the surface of the papilla where they gradually thin out while the main sheet continues upward into the column of Bertini to form a dividing septum between contiguous pyramids. This presumably makes the fornix much weaker than any other point in the pelvis. It would seem quite probable that the factors controlling the locus of rupture have a mechanical basis because the rupture is always at this point whether the kidney is diseased or not.

The rupture of the pelvis allows extravasation of the pelvic contents into the fat-laden sinus renalis with its arterial and venous trunks. If as sometimes happens this is the only damage done there is no pyelovenous backflow but merely an extravasation into the sinus renalis and upward along the connective tissue septa between the pyramids. Usually however when sufficient pressure has been exerted to rupture the renal pelvis the dilatation has been great enough to place tension upon the thin-walled venous collar which often surrounds the calyx and has been great enough to tear it. From the proximity of the tip of the fornix to these venous rings one can easily understand how in the event of tears in both fluid would find its way into the blood stream rapidly and in large amount. Once in the arcuate veins the mass injects the stellate and intralobular veins to the periphery of the cortex and the venæ rectæ for a short distance.



Fig 5 A minor calyx opened to show multiple point of rupture at the margins of the papilla where the pelvis is reflected over the papilla. The relation of the point of rupture to the venous ring and the pathway of the injection mass is indicated

down into the medulla and of course frequently emerges from the renal vein

In the serial sections these tears in the thin walled veins can sometimes be demonstrated. To those who have attempted such a demonstration no allusion to its difficulty need be made. To be absolutely sure that a given tear has been caused by the force of an injection fluid and that it is not an artifact caused by the microtome knife or faulty imbedding is a point requiring nice discrimination. It must suffice to state that tears have been found which to a number of trained observers seemed in all likelihood to be due to fluid pressure. These tears have all occurred either in the venous ring itself or in the ascending branch at a point so close that dilatation of the calyx with attending strain upon the connective tissue septa could have caused them. In the cleared serial sections the distribution of the ink in the tissues is such that the point of entry of the injection fluid into the vein is easily proved to be in one or the other of the thin walled veins of large caliber that is in the inner anastomotic ring or in the ascending branch of an arcuate vein very close to its junction with the venous ring. In other words there does not seem to

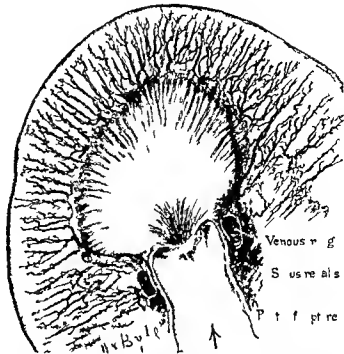


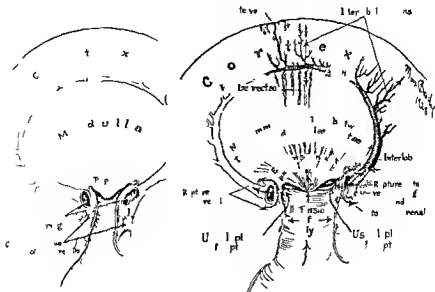
Fig 6 A longitudinal section through a renal pyramid and minor calyx. The relation of the points of rupture to the venous ring and the arcuate veins is seen as well as the injection of the interlobular veins and the venae rectae. The injection of the collecting ducts through the papillary foramina is shown to extend a short distance into the medulla

be any possible doubt as to the pathway traversed. The only question that does seem not to be absolutely demonstrated or demonstrable is the most usual site of tear in the vessel. Indeed it is most probable that this varies somewhat. In our series of specimens it did seem to vary over a distance of about 0.5 centimeter.

Despite these minor difficulties we feel that this is the correct explanation of the phenomenon as it has been traced repeatedly in the cleared sections and serial sections as well as verified by dissection of the macerated specimen.

The injection mass usually enters some of the papillary ducts and passes a short distance upward into the collecting tubules. It rarely extends so far as the injection coming down through the venule rectae. It is needless to say that there is no connection between them. Figure 7 presents our concept of the mechanism of pyclovenous backflow.

The pathway of the injection mass from the pelvis into the venous channel does not



The chemical degradation effects of the alkyd
dithiophosylated by the junction of the product of pyrolysis

always lead directly from the point of rupture into the nearest venous collar this is not always torn. But it may permeate the peripelvic fat forcing its way through lines of cleavage creating a reservoir of fluid under tension in the sinus renalis and eventually creep outward beneath the renal capsule. Occasionally after traversing a portion of the sinus renalis connection is made with a distant venous collar that has been torn with subsequent injection of the venous system. This has been observed in two of our specimens.

The route of injection has been described by some writers as being from the point of rupture in the pelvis into the venæ rectæ of the medulla and thence into the arcuate vessels. In all likelihood this is not correct. The venæ rectæ are not injected except for a short distance downward from the arcuate vessels. Furthermore it would seem impossible to account for the occurrence of massive injection of the venous tree if such narrow channels as the venulæ rectæ were the connecting link.

OCCURRENCE OF PNEUMOVENOUS BACKFLOW

A study of the protocol of the experiments reveals that in 36 kidneys 20 came within

the definition of pyelovenous backflow that is the injection mass either flowed freely from the renal vein or was observed in the stellate veins beneath the capsule at the pressure indicated. In 55 per cent of the kidneys then there was rupture of the pelvis and extravasation into the arcuate veins. This however is not as high a percentage as has been described by other investigators.

The significance of this figure is modified further by examination of the stained microscopic sections as indicated in the protocol. In no kidney was pyelovenous backflow produced at pressures below 100 millimeters of mercury where there was not present either some definite pathological factor or autolysis of the kidney tissues. On the contrary a number of the fresh normal kidneys with stood pressures as high as 0 millimeters of mercury without rupture of the pelvis. All of the normal well preserved kidneys with stood pressures of at least 10 millimeters of mercury without rupture. This would seem to indicate that pyelovenous backflow was definitely not a normal mechanism but rather one associated with pathological changes in the tissues plus increased pelvic pressure that increased pressure alone within

PROTOCOL

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| 4 | | | h | | ⁵⁰⁰ g l t k
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| 5 | + | + | 36 h | + | ⁵⁰⁰ g l t k
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| 6 | | | h | | ⁵⁰⁰ g l t k
l d k | | 6 | N |
| 7 | | | 3 h | | ⁵⁰⁰ g l t k
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PROTOCOL—Continued

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| 5 | | | 3 h | | I d
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| 6 | | + | 4 h | + | I d
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| 7 | + | + | 47 h | + | I d
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| 35 | + | + | 7 h | + | 5 ^{ov} g lat
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| Pr | mll m t | | | f m y | | | | | | | |

the physiological limits of the kidney (100 mm) could not produce it

CLINICAL SIGNIFICANCE

The foregoing statements must not be interpreted by those injecting kidney pelvises for clinical studies as minimizing the necessity for care in regulating the amount of pressure used. In these experiments all the kidneys used appeared to trained pathologists to be normal upon gross inspection. And yet some of the kidneys ruptured at pressures which were as low as 30 millimeters of mercury.

The clinician often has no means of knowing whether or not he is dealing with a diseased

kidney and for this reason he should always use some method of injecting the opaque solutions which will ensure safety. Radial shadows extending outward from the calyces of the kidney in the X-ray plate always indicate that damage has been done.

A column of 12.5 per cent sodium iodide solution 45 centimeters (18 inches) in height exerts a pressure of 30 millimeters of mercury. This pressure is always sufficient for making a pyelogram and probably exceedingly rarely if ever will such a pressure cause rupture of the renal pelvis.

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 l 60 6 2
 5 HUMAN d RE E ILL J Am M A 19 6
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 6 KELY d BUR A f D ea s f th k d s Bl dde
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CLINICAL SURGERY

FROM THE WASHINGTON UNIVERSITY SCHOOL OF MEDICINE

SHORTENING OF BROAD LIGAMENTS AND ELEVATION AND REPAIR OF UTEROPUBIC FASCIA FOR UNCOMPLICATED PROLAPSE OF UTERUS AND BLADDER

H S CROSSEN, MD, FACS, St. Louis
P f 1 Cl 1 Gy 1 gy

EXPERIENCE has shown that uncomplicated prolapse of the uterus and bladder no matter how severe can be permanently corrected without the extensive abdominal operations or the extensive vaginal operations frequently employed for it. Abdominal operation is required in prolapse only when there is some complicating condition necessitating abdominal section. Vaginal hysterectomy is required only when there is some complication necessitating removal of the uterus.

The broad ligaments are the main supporting structures of the uterus in the upper pelvic plane. The principal part of the supporting tissue of each broad ligament lies in the lower portion forming a strong mass of tissue extending from the cervix uteri outward and upward to the pelvic wall in the region of the white line. So important is this in supporting the uterus that it has long been designated the ligamentum cardinale. In all cases of uterine prolapse this ligamentum cardinale of each side is stretched out to undue length—it must be otherwise the uterus could not sink into prolapse. When this strong portion of the broad ligament of each side is adequately shortened a most important step has been taken toward permanent correction of the prolapse. The lower portion of the broad ligaments may be shortened by simple coaptation in front of the cervix or by division and overlapping in front of the cervix. The former method was devised in 1903 by Aleksandroff¹ and the latter in 1906 independently by Dudley and Hertzler.²

The uteropubic fascia supports the base of the bladder. In the extensive disturbances of parturition resulting later in prolapse of the bladder the supporting power of the uteropubic fascia is

damaged in two particulars. First its uterine attachment is displaced downward toward the end of the cervix and second it is greatly over-stretched in all directions. The downward displacement of the uterine end of the fascia is corrected by restoring its attachment high on the uterus which is an important step in operating for bladder prolapse. This step aids also in correcting the uterine prolapse for when this fascia is properly attached above the pivotal area of the uterus it tends to keep the corpus uteri forward and the cervix back. This downward displacement of the attachment of the fascia and vaginal wall in prolapse and the necessity of elevation of the same were recognized as early as 1889 by Hadra³ of Texas who set forth his views in a most interesting and instructive paper. Gradual improvement since then has given the present effective and simple technique for elevation of the uterine attachment of this fascia. The over-stretched condition of the uteropubic fascia is corrected by the excision or the overlapping of the redundant portions thus restoring the side to side sling support under the bladder. The importance of this fascial layer under the bladder and the necessity of eliminating the laxity by coaptation of certain portions was described and illustrated by Martin of Germany in his book published nearly twenty years ago. Additional instructive articles on the anatomy and surgery of this region by later workers have contributed to the satisfactory method of suture approximation now in use. The overlapping method in which the fascia is separated from the vaginal wall and the redundant portions overlapped was developed independently by Rawls⁴ and Neel.⁵ The anatomical and mechanical features of this overlapping method have

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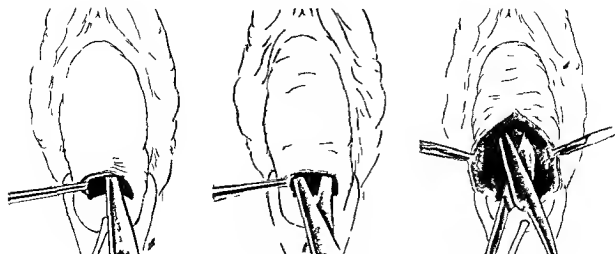


Fig 1 B g g th p t f the a l wall
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 th bl dd
 I S p d w d g th f ep to
 B p t t f th p of thru ng f w rd th blu t

so h t d t nc d th op g the bl d the
 de d p t may b m de p d l y a d f ly A the
 bl ts p t p h d f w d t h l d b d ct d
 g t th ag l all a d w f om th bl d d e w ll
 th t th d a g of j g th bl dd ll m y b
 l m t d
 Fig 3 Th p t d w ll d ded s y t
 f cilt t ga at gh

quite an appeal but after employing it for a time I went back to the simple approximation method described below which ordinarily accomplishes what is necessary in less time and with less tissue disturbance. In exceptional conditions however overlapping may be decidedly advantageous.

TECHNIQUE

The combination operation for shortening of the broad ligaments and elevation and repair of the uteropubic fascia is carried out in the following steps: (1) separation of vaginal wall from bladder (2) separation of bladder from uterus (3) exposure of lower part of each broad ligament (4) placement of broad ligament sutures (5) excision of excess fascia and vaginal wall (6) placement of fascia elevating sutures (7) the tying of broad ligament sutures and then of fascia elevating sutures (8) completion of the suturing of fascia and vaginal wall and (9) repair of pelvic floor.

1. *Separation of vaginal wall from bladder.* This step may be conveniently begun by making a small incision with scissors just in front of the cervix (Fig 1) and then working forward with the blunt scissors between the vaginal wall and the bladder. The separation may be made rapidly and safely by thrusting the closed scissors forward a short distance under the vaginal wall and then opening them as indicated in Figures 1 to 3. This process is kept up until the required separation in

the median line has been secured. The blunt point of the scissors is to be directed against the under surface of the vaginal wall to avoid injury to the bladder wall. The separated vaginal wall is divided as needed for advantageous work (Fig 3). After the separation in the median line is completed gauze dissection is employed to separate the vaginal wall laterally (Fig 4). This lateral separation is continued on each side around the bladder until the bladder can be picked up as shown in Figure 5.

If preferred the separation of the vaginal wall may be begun by a median incision with the knife. The incision passes through the vaginal wall proper and the underlying attached fascia. There are two planes of cleavage, one not very apparent in the median line between the vaginal wall and the fascia and the other more evident between the fascia and the bladder wall. The separation should take place along the latter plane so that the fascia remains attached to the vaginal wall. This cleavage plane between the fascia and bladder wall is most easily identified in the posterior part of the incision near the cervix; consequently it is well to begin the separation there.

2. *Separation of bladder from uterus.* Laterally the bladder is easily pushed off the cervix but in the median line it is usually held by some connective tissue fibers which must be divided with scissors or

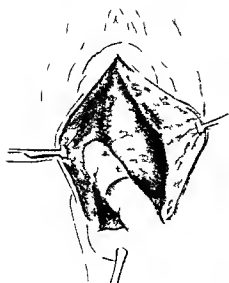


FIG 4

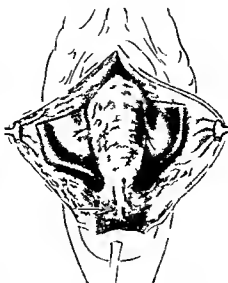


FIG 5

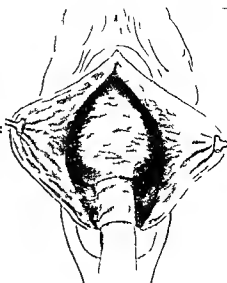


FIG 6

FIG 4 The vaginal wall with attached uterovaginal fascia has been separated and divided all along the median line. The separation has been made well around the bladder on the patient's left side and is being made on the right side. This separation may be made rapidly by gauze dissection as indicated.

FIG 5 Picking up the bladder to identify the vesico-uterine fibers that must be cut to facilitate separation of the bladder from the uterus. The arrow indicates the safe area

in which to cut the fibers close down near the uterine wall.

FIG 6 After the vesico-uterine fibers shown in Figure 5 have been divided the bladder may be easily pushed off of the uterus by the gauze covered finger as here shown. The bladder separation is continued up to the area of the vesico-uterine peritoneal fold and then a retractor is introduced to hold the bladder out of the way of the subsequent work as shown in Figure 7.

knife. This group of fibers which has been designated the uterovesical ligament is indicated by the arrow in Figure 5. It is made tense for identification as shown in the illustration and is divided near the cervix. Then the bladder is easily pushed off the uterus by gauze dissection (Fig 6) up to the vesico-uterine peritoneal fold.

3. *Exposure of lower part of each broad ligament.* The vaginal wall with its underlying fascia is loosened laterally by gauze dissection and then divided with the scissors as in Figure 7 so as to give good exposure of the lower portion of each broad ligament.

4. *Placement of broad ligament sutures.* These sutures shown in Figure 8 are of 40 day catgut No. 1 or 2 as preferred. They take firm hold of the lower part of the broad ligament on each side far enough out so that when tied they will take up the slack in the ligaments. If there is any doubt as to just how far out to place these sutures test the selected site on each side by picking it up with a forceps and bringing the two together in the median line at the same time pushing the uterus back and up in the pelvis. These sutures are left untied and long and each is held by a forceps (Fig 9).

5. *Excision of excess of fascia and vaginal wall.* The excess of each flap is trimmed away as indicated in Figure 9. Sufficient flap should be left

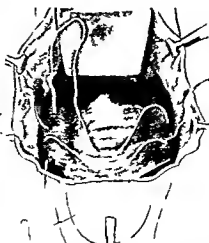
on each side to permit suturing together in the median line without tension. On the other hand marked laxness of the repaired structures should be avoided. As a rule the line of excision will extend from the outer limit of the lateral incision at the cervix directly forward to the anterior end of the median incision (Fig 9). During closure of the anterior part of the incision if the anterior portion of the flaps are found still rather lax they may be then further trimmed as needed.

6. *Placement of the fascia elevating sutures.* These sutures which elevate the uterine attachment of the fascia above the pivotal area of the uterus are shown in Figure 10. They pass through the trimmed flaps (consisting of vaginal wall and underlying fascia) at about the junction of the middle third with the posterior third (Fig 10). They take firm hold of the anterior uterine wall just below the vesico-uterine peritoneal fold that is one third to one half the way up the uterus. The object of this high uterine attachment of the fascia is to hold the corpus uteri forward and at the same time shorten the fascia so as to take out the anteroposterior slack and give good support under the bladder as shown in Figure 12.

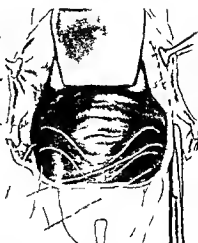
7. *The tying of the main sutures.* The uterus is pushed inside the pelvis and the two broad ligament sutures are tied the broad ligaments being folded in front of the cervix (Fig 11) and the



F 8

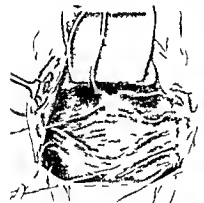


F 9



F 10

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F 11



F 12



F 13

F 11 Th f l t g t Th tur
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lack being taken up so that the cervix is held well back in the pelvis. The fascia elevating sutures are then tied. They should draw the corpus uteri forward and also give good support under the bladder (Fig. 11).

It is important to place all the main sutures before any of them are tied, as it is difficult to reach the uterus after tying begins.

Completion of the suturing of fascia and vaginal wall. A few interrupted sutures complete the closure of the vaginal wound, thus approximating the fascia and attached vaginal wall. The two or three closing sutures required back of the fascia elevating sutures (Fig. 13) may be placed before the main sutures are tied, if preferred. When closure of the anterior part of the wound is begun



Fig. 13

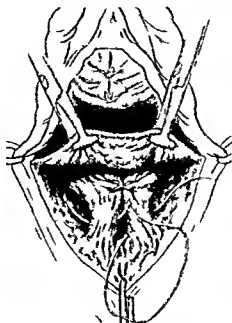


Fig. 14

Fig. 13 The tysofaeleating sutures are indicated by the heavy knot with rather long ends. The posterior part of the vaginal wound has been closed by two sutures and the anterior part by one. If preferred the two posterior sutures may be passed before the broad ligament and fascia eleating sutures are tied.

Fig. 14 Effective repair of the pelvic floor is an important step in all prolapse operations.

if the trimmed flaps are found still too redundant they may be trimmed further as needed before the closing sutures are placed (Fig. 13). As to suture material, 40 day catgut No. 1 or 2 is preferred is very satisfactory for use throughout.

9. *Repair of pelvic floor* Repair of the pelvic floor (Fig. 14) is of course required in all operations for prolapse.

CONICAL EXCISION OF CERVIX

In those cases in which laceration of cervix and chronic cervicitis require excision of the affected area with the uterus otherwise in good condition for preservation, conical excision is added to the above technique. As the excision of the cystic area of the cervix causes considerable bleeding, it is well to postpone it until the main sutures are in place as indicated in Figure 15.

The affected glandular area of the cervix is then excised as indicated (Figs. 15 and 16). It is important to excise no more widely nor deeply than necessary to remove diseased tissue. Unnecessarily extensive excision increases the troublesome bleeding and the chance of later stenosis.

An anterior and posterior Sturmendorf suture of chromic catgut will turn in the margins and



Fig. 15

Fig. 15 When conical excision of the cervix is required on account of laceration and cervicitis, it may be conveniently carried out just after the main sutures are passed as here indicated. The incision has been continued around the cervical opening to include the affected tissue which is removed as a cone.



Fig. 16 The cone of affected tissue has been removed and the posterior Sturmendorf suture passed and tied drawing in the posterior flap. The anterior Sturmendorf suture is being passed. When this is tied it draws in the anterior flap. Then a suture or two on each side complete the cervical work, and the remaining step of the operation may be proceeded with as usual.

heck most of the bleeding. The hæmostatic effect of these sutures is increased by placing the entrance and exit a considerable distance apart as shown in the illustrations. One or two sutures on each side complete the inversion and hemostasis. The operator may then proceed with the main operation by pushing the uterus inside the pelvis and tying the broad ligament sutures.

FOTHERGILL OPERATION

In this connection mention should be made of the Fothergill operation which is used so extensively in England and associated countries. It is described by Fothergill as a colporrhaphy with a special outline of denudation by which the excess vaginal wall is excised. The excision of vaginal wall extends well laterally at the vault and in most cases there is an excision of the cervical neck with the vaginal denudation. After the denudation the shortened vaginal walls are united in the median line and about the denuded cervix. Though the description of the operation is devoted exclusively to the outline of denudation and the suturing of vaginal wall and cervix, the good results indicate that there is considerable shortening of the broad ligaments and repair of the uteropubic fascia—these two important features being incidentally included more or less effectively in different cases depending on the details of tissue exposure and the suturing employed by individual operators. Probably many operators purposely pass the sutures into the deeper tissues. In fact I know one Australian advocate of the operation who recommends placing a special suture to catch up tissue in the broad ligament area.

Experience long ago demonstrated that colporrhaphy (vaginal wall suturing) does not give lasting support against pressure. It was this stretchability of the repaired elastic vaginal wall in the colporrhaphies of pioneer gynecology that necessitated the deliberate study as to the best method of including the deeper strong supporting tissues in the suturing. The result of this extensive study by many workers over a long period is the effective method of shortening the broad ligaments and elevation and repair of the uteropubic fascia explained in this article. Permanent results from the Fothergill operation or any other method of denudation and suturing will depend on the extent to which these two essential features are included. These two essential features are not even mentioned in the Fothergill operation while the particular point that is stressed namely the method of denudation seems to me distinctly

disadvantageous. The undue length of time consumed in the operation as I have seen it could be materially reduced by employing a less tedious method of vaginal wall dissection and also by omitting the cervical amputation except when really needed.

INDICATIONS

No one operation is best for all cases of prolapse. In this as in other pelvic lesions the patient should have the benefit of *selective* treatment. The accompanying conditions differ much in different cases and require different operative methods. In each case the various pathological conditions present should be accurately determined and then the operative method best meeting those conditions should be employed. Some patients have complications necessitating abdominal section and in such it may be advisable to complete the operative work for the prolapse by that route, the pelvic floor also of course being repaired. The prolapsed uterus may be so diseased that it must be removed by abdominal or vaginal hysterectomy—the hysterectomy to be followed by adequate steps to restore the upper and lower supporting planes of the pelvis.

In this article I have considered just one class of cases of prolapse of the uterus and bladder namely the *uncomplicated*. This is a large class comprising many patients and for each of them the operation described (shortening the broad ligaments with elevation and repair of the uteropubic fascia) is very satisfactory. It is simple and effective. It accomplishes what is needed without unnecessary risk from extensive manipulations in the peritoneal cavity or from undue prolongation of the anesthesia. It is applicable both in the childbearing period and in later life. As already explained excision of the cervix when required for chronic cervicitis or cystic change works in very well as a part of the operation.

There is another operation that divides the field with this one after the menopause and that is the interposition operation. The Wertheim-Watkins interposition operation in which the corpus uteri is interposed between the raised bladder and the anterior vaginal wall is so generally used and well known that a detailed description is unnecessary. For the aged patient with extensive bladder prolapse it has the distinct advantage that it interposes a firm body under the base of the bladder for support instead of just the connective tissue which is sometimes quite atonic and stretchable in these patients. Either operation may be carried out under regional or local anesthesia when conditions make it advisable to do so.

FROM THE DEPARTMENT OF SURGERY EDINBURGH UNIVERSITY

EXCISION OF THE RECTUM FOR CARCINOMA

D P D WILKIE MCh FRCS FACS EDINBURGH SCOTLAND
P f f s g y Ed b gh U ty

A STUDY of the pathology of cancer of the rectum reveals the fact that the disease in the majority of cases remains a local one for a considerable period probably at least a year after its first beginnings. This fact lends hope to our efforts in radical extirpation. The ideal operation of excision of the diseased segment of the bowel with the re-establishment of its continuity and the maintenance of the integrity of the sphincters is so seldom feasible that it cannot yet be considered to be in any sense a standard operation in surgery. Practically all surgeons are agreed that a complete removal of the rectum with its fascial investments and its immediate lymph shed is demanded and that with this a permanent colostomy must be made.

In favorable subjects the abdominoperineal operation is so long advocated and practised by Miles is undoubtedly the operation of choice. Carried out properly in one but possibly in two stages it gives a removal of the diseased segment scientifically adequate and technically sound. The disquieting fact remains however that in approximately 50 per cent of the cases met with in practice this operation presents difficulties and risks which are serious if not unjustifiable and we are faced with the alternatives of merely adopting an expectant attitude of doing a palliative colostomy of treating with radium or of extirpating the diseased bowel by an operation which is less radical and therefore from the pathological standpoint less satisfactory but which involves much less immediate risk and is therefore applicable in a much wider range of cases. The latter consists of the perineal operation following on a preliminary colostomy an operation with a very wide range of applicability and a low mortality (less than 10 per cent). It is this operation which we practice as the standard reserving the abdominoperineal method for the favorable case viz the spare wiry subject of 60 years or under

not excluded. Gross soiling of the wound may occur from a tear in the bowel at or near the tumor during the operation—a rare accident. A more subtle form of sepsis is that from the severed lymph vessels draining from the infected and ulcerated growth and this in some degree is inevitable. By careful preliminary treatment this lymph borne infection can be met successfully.

PRELIMINARY COLOSTOMY

In a case in which the obvious signs of metastasis are absent and the growth is not immovably fixed the patient is given a general anæsthetic and the abdomen is opened through a mid left rectus incision. Evidence of peritoneal and hepatic involvement is searched for and if excluded the upper limits of the growth and any spread by contiguity established. The presence of palpable glandular involvement along the superior hemorrhoidal vessels is determined and if this be not excessive the feasibility of a subsequent radical operation is clear. The upper portion of the pelvic colon loop is brought out over a glass rod through the upper part of the abdominal wound which is then closed in layers. Three days later the loop is cut across to establish a permanent colostomy.

PERIOD OF PREPARATION

The length of the interval of time between the colostomy and the radical operation is determined by the general condition of the patient. In cases in which there is a large ulcerating growth and the patient is exhausted and anæmic an interval

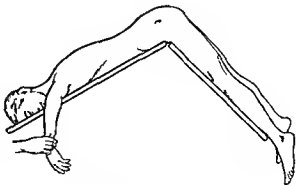


Fig 1 Diagam showing position of patient for operation

DANGERS OF THE OPERATION

The dangers are three in number—shock, hemorrhage and sepsis. The first two can be readily eliminated if the excision operation is performed under twilight sleep and spinal anaesthesia. The factor of sepsis can be minimized but

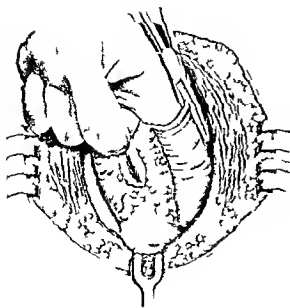


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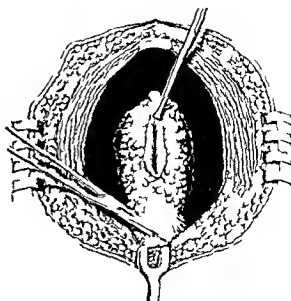


Fig 4 D n of ecto cth al m cl

of 3 or 4 weeks may with benefit be allowed. In the average case 3 weeks is the rule. During this period the bowel above the colotomy is well cleared out and the lower segment containing the growth is washed out and rendered as clean as possible. A marked improvement in the patient's

general condition results. As repeated observations had shown us that the infection following the second operation was a mixed one and almost invariably was due to a streptococcus and bacillus coli we have now for 14 years taken advantage of the interval to give preliminary inoculations of streptococcal and bacillus coli vaccines in doses of ten million of the former and fifty million of the latter on two occasions namely 10 days and 3 days before the second operation. The value of this treatment we have shown experimentally to be enhanced by giving 3 cubic centimeters of 5 per cent nucleic acid subcutaneously the night before operation to induce a leucocytosis (the average leucocytosis thus induced is 12,000). We believe that the resistive powers of the patient are thus mobilized before infection has gained a footing.

RADICAL OPERATION

Two hours before operation morphia $\frac{1}{4}$ grain and scopolamine $\frac{1}{100}$ grain is given. One hour before operation morphia $\frac{1}{6}$ grain and scopolamine $\frac{1}{200}$ grain is given. When brought to the theater the patient is in a deep sleep and does not awake when through a lumbar puncture 0.7 cubic centimeter of 10 per cent stovaine (Billon) is administered. For 7 minutes thereafter the patient is allowed to rest in the recumbent position and in the male a rubber catheter is meanwhile introduced *per urethram* and stitched in position. The patient is now turned over into the prone inverted V position with the head and feet

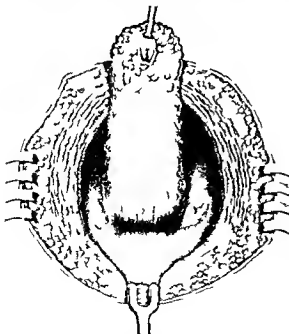


Fig 4 Iott p d n l p of D o l l
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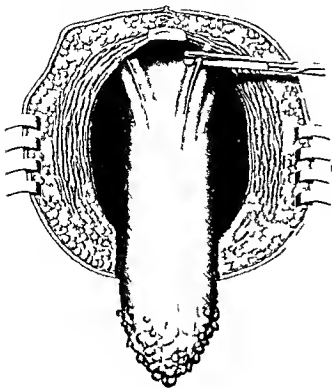


Fig 5 Division of sling ligaments of the rectum

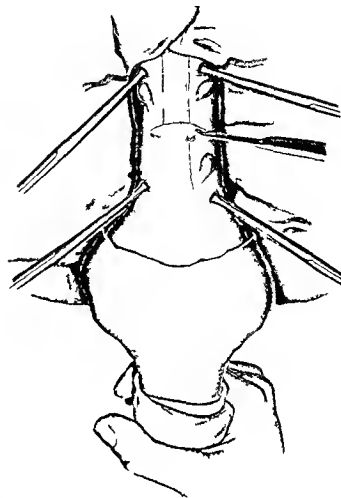


Fig 6 Pelvic colon steadied by peritoneal forceps while peritoneal and muscular coats are divided round the whole circumference by a sharp knife

low and the buttocks uppermost (Fig 1). This position has certain advantages viz the field of operation is the highest point in the body and is relatively bloodless the operator stands over the field of operation a position to which he is accustomed with spinal anaesthesia the head low position is that associated with fewest after symptoms

STEPS OF OPERATION

1 The anus is closed by an encircling silk suture

2 An elliptical incision encircling the anus and removing three quarters of an inch of skin around it is carried upward to the sacrococcygeal joint and forward to the mid point of the perineum

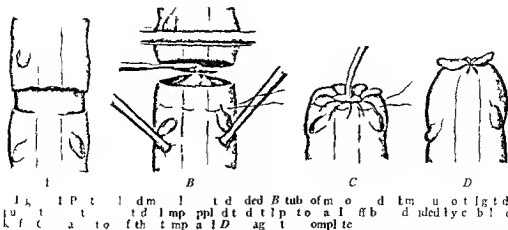
3 The structures attached to the coccyx namely the gluteus maximus and external sphincter and in front of these the levator ani and the coccygeus muscles and portions of the sacrospinous ligament are severed and the coccyx disarticulated by pressing its tip forward and entering its joint with the sacrum from behind

4 Two fingers can now be passed readily up into the hollow of the sacrum and working from behind forward the ischioanal fat on either side is severed at its outer limit and the inferior haemorrhoidal vessels are secured and ligated

5 The levator ani muscle on each side is now divided from behind forward by the insertion of

a finger of the left hand deep to the muscle and division with scissors as near as possible to its pelvic attachment (Fig 2)

6 The recto urethralis muscle must now be divided. This muscle which represents the most anterior fibers of the levator ani serves to connect the rectum to the membranous urethra and the accurate division of it constitutes an important stage of the operation (Fig 3). The tendency is to cut too near the urethra in an effort to avoid a wound of the rectum and this may lead either to a wound of the urethra or to entrance into the sheath of the prostate instead of the opening up of the space of Denonvilliers. After division of the recto urethralis the finger can be passed upward readily between the prostate and the rectum (Fig 4) unless in low seated growths which infiltrate the prostatic sheath. In the case of the latter the sheath and a portion of prostate may be sacrificed without untoward results



The *slight ligaments* or fascial bands containing the middle hemorrhoidal vessels can now be easily felt on either side preventing further delivery of the rectum. They must be secured in forceps as high up as possible cut and ligated (Fig 5).

5 The *peritoneum* is opened and divided well around to either side of the rectum. It will always be found that division of the lateral reflections of the peritoneum allows the rectum to come down freely.

6 The lowest part of the pelvic colon can now be grasped and brought down and the further descent of the rectum is impeded merely by its vascular pedicle containing the superior hemorrhoidal vessels. It is desirable to ligate these

vessels as high up as possible and it is often an advantage to divide the bowel and invaginate the upper end before the vascular pedicle is tackled.

7 *Division and invagination of the colon* may be greatly simplified by the adoption of the cuff method (Fig 6). The site for division which must be at least 3 inches above the upper limit of the growth is put on the stretch and with a sharp knife the peritoneum and muscular coats are divided all around leaving a relatively slender tube of submucous and mucous coats (Fig 7). A catgut or fine linen purse string suture is inserted in the bowel three quarters of an inch above the cuff and then a strong catgut ligature (No. 2) is tied round the denuded portion. A light clamp is applied distal to the ligature and the bowel cut through with a carbolic knife or the cautery. The bowel proximal to the purse string suture is then steadied with two Allis forceps the stump invaginated and the suture tied. By the use of this cuff method all difficulties with subperitoneal fat and hypertrophied and oedematous muscle which may be considerable are avoided and a stump devoid of tension and therefore adequately supplied with blood results.

8 *The ligation of the vascular pedicle* containing the superior hemorrhoidal vessels is now effected and this can frequently be done almost 3 inches higher than the division of the bowel. As this is the most important route of lymph spread it represents perhaps the most vital step in the operation. It is best done by the passing and tying of the ligature without the application of any forceps or clamp.

9 *The closure of the peritoneum* of the pelvic floor by a continuous catgut suture which fixes the colon stump in the suture line completes the operation (Fig 8).

The cavity left is a large one and in the male especially there is no means of obliterating it. In

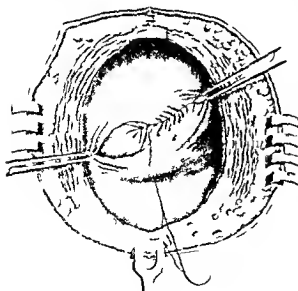


Fig 8. Closure of the peritoneum of the pelvic floor by a continuous catgut suture which fixes the colon stump in the suture line. completes the operation (Fig 8).

many cases it must inevitably be mildly infected from the number of severed lymphatics running from an ulcerated area. *It is wiser, therefore to drain freely* by means of a large tampon of gauze covered by perforated oiled silk. One or two fishing gut sutures are inserted at the extremities of the wound the major portion of which is left open.

AFTER TREATMENT

The patient is put back to bed with the foot of the bed raised one foot and is left in this position for 12 hours. This prevents postoperative head ache probably by precluding the seepage of cerebrospinal fluid from the lumbar puncture. At the end of 12 hours the head of the bed is raised to allow of descent of the pelvic floor and thus a diminution in the size of the cavity left by operation. The packing is removed at the end of 48 hours and daily thereafter the wound is irrigated with weak eusol solution and lightly packed. On an average 7 weeks are required for the healing of the wound. Passage of a catheter is almost always required for several days. The bladder should not be allowed to become distended or a cystitis will inevitably follow catheterization. Urinary infection is one of the most troublesome complications of the operation and in a few cases

it may actually threaten life. While some surgeons advocate the tying in of a catheter for several days after operation special precautions being taken to prevent infection along the catheter we have preferred to rely on repeated catheterization. Where prior to the operation there has been urinary difficulty from enlargement of the prostate the establishment of suprapubic drainage by means of a Pezzar catheter should be considered. We have carried out this method in two cases and we have found that it certainly gives great comfort.

Shock is absent after the operation described above. A certain amount of infection of the wound is usually found. This gives rise to no anxiety and serves a useful purpose in that the inflammatory reaction tends to kill off any outlying malignant cells which may have escaped removal and it also seals the lymphatics by the fibrosis which inevitably follows.

The patient should be out of bed on from the tenth to the fifteenth day except in elderly subjects. For the colostomy some form of cap is fitted and the patient is encouraged by experimenting with his diet to find one which will result in a soft solid motion *without the use of any aperients*.

the intestine resected. The patient made a recovery and was well 3 months later.

CASE 2. Reported by Hartshorn. A man without premonitory symptoms suddenly developed an attack of intestinal obstruction with tenderness in the right lower quadrant. At operation an ileocecal intussusception was found. It was easily reduced. No tumor was noted. On the tenth postoperative day symptoms recurred and at operation evidence was thought to be found of obstruction due to adhesions. On this occasion however a tumor 6 cm. long at the previous operation was found in the ileum 18 centimeters from the ileocecal valve. It may be presumed that the second attack was in reality due to a recurrent intussusception which was spontaneously reduced. The tumor proved to be a fibroma.

CASE 3. Reported by Collier. A woman of 26 years had had attacks of abdominal pain and vomiting at intervals of months. At operation a small adenoma of the ileum 20 centimeters from the caecum was found and removed. Two months later the symptoms recurred and at the second operation an intussusception 15 centimeters proximal to the site of the old operation was found. It was easily reduced. A few days later the same symptoms recurred but operation was refused until 6 months later when after marked loss of weight and persistence of obstructive symptoms an operation was done when a pedunculated tumor of the jejunum was found 60 centimeters above this intussusception. Both tumor and intussusception were resected and the patient recovered.

CASE 4. Reported by Wardill. A man of 43 years gave a history of intermittent attacks of abdominal pain for 7 months and fresh blood in the stool the day before admission. Symptoms pointed to partial obstruction. At operation an intussusception of the descending colon was found which was easily reduced. No tumor was found at the point of the intussusception but 5 inches proximal there was a small firm carcinoma. Three weeks later the abdomen was reopened for the purpose of removing the growth and it was found that the intussusception had recurred and the tumor was then at the apex of the intussusception. It was resected and recovery ensued.

CASE 5. Reported by Barnn ton. A girl 6 years of age gave a history of attacks of abdominal pain and vomiting for 2 years. Examination showed a palpable abdominal tumor. Laparotomy disclosed an intussusception of the jejunum which was easily reduced with recovery. No tumor was noted. Two weeks later the symptoms recurred and at a second operation another intussusception was found at the same site which was again easily reduced. On this occasion lesions which appeared to be tubercles were noted on the peritoneal surface. The symptoms recurred irregularly and 10 months later a third operation was done revealing an intussusception of the jejunum at no less than 3 separate points. Again reduction was accomplished and the bowel carefully examined but no definite tumor felt. On 2 occasions during convalescence a recurring intussusception was reduced by manipulation through the abdominal wall. One month later a fourth operation was necessary when an intussusception was again found and reduced. On careful examination it was then possible to feel distinctly two groups of tumors in the bowel some 6 inches apart and it was evident that these were the cause of the intussusception. A resection was done and the patient recovered. Pathological diagnosis adenomyoma.

CASE 6. Reported by Lee. A woman 40 years of age gave a story of recurring attacks of pain in the right lower quadrant. At the first operation the appendix was removed and found to be normal. Symptoms continued and 2 months later assumed the character of obstruction. At a second operation a double intussusception of the ileum

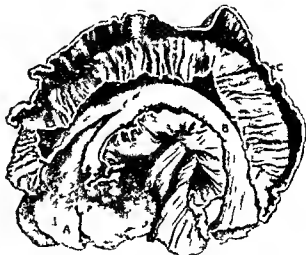


Fig. Portion of ileum resected (Surg. No. 4053) showing: A tumor B intussusceptum and C intussusception.

was found which was easily reduced with recovery. Three weeks later the symptoms recurred and at a third operation an intussusception identical with the previous one was discovered. It was reduced and a tumor was felt within the bowel. The intestine was resected and the patient recovered. Pathological diagnosis fibroblastoma.

CASE 7. Reported by Graham. A boy about 14 years of age gave a history of cramp-like abdominal pain for 6 weeks. At operation an ileocecal intussusception was found and easily reduced. Subsequently attacks of pain and vomiting continued and 5 weeks later a second operation was done and the ileocecal intussusception was again found. Reduction was impossible on this occasion and the bowel was resected and showed on examination a round cell sarcoma of the terminal ileum. Patient recovered.

CASE 8. Reported by Watts. A man 4 years of age gave a history of cramp-like abdominal pain and occasional vomiting for 3 years and entered the hospital with symptoms of acute obstruction with visible peristalsis and a palpable mass. At operation an intussusception of the lower ileum was found and easily reduced. Two pedunculated tumors were palpated within the intestine but removal was not attempted at this time. The symptoms recurred one week later and at a second operation a similar intussusception was found and was with difficulty reduced. The intestine was resected and the patient recovered but had an intestinal fistula for some months. At a third operation a pedunculated tumor was found in the sigmoid which was resected. Examination of the rest of the intestines showed numerous small pedunculated tumors. A lateral anastomosis was done around one which seemed to be producing an invagination. The patient recovered. Three months later a fourth operation was necessary at which 7 pedunculated tumors were removed and another lateral anastomosis performed. The patient recovered and was well 4 months later.

CASE 9. Reported by Cope. A man 21 years of age gave a long story of attacks of violent abdominal pain for which appendectomy was done without relief. At a subsequent attack visible peristalsis was detected and at a second operation adhesions were found which were thought to be the cause of the obstruction and were freed. One week later on account of recurrence of symptoms a third operation was done and an intussusception of the jejuno-ileum at about its mid portion was found and reduced. Search

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 f l l t h i s t o m o d s e r l d n o
 l p l p d l e i d T h e p a t t r o d
 l t t e t g t h t h j t t t e h d a m l t
 t y d a t p t o n a n t s p t o u d h y a n
 d n m f o n d n d e t e d S h e l o e c o d

These 13 cases may be divided into 4 groups on the basis of treatment given and the failure of the surgeon to recognize the complete pathology.

Group 1 At the first operation the intussusception was found and reduced but the tumor which caused it was overlooked thus necessitating a second operation for its removal. This happened in 8 instances.

Group 2 At the first operation an intussusception was reduced and the tumor resected but a second tumor was overlooked which later caused another intussusception and required a second operation for resection.

Group 3 At the first operation a tumor not accompanied by intussusception was found and resected at a second operation an intussusception was reduced but the causative tumor overlooked.

a third operation was necessary to resect the second tumor when it caused a recurring intussusception.

Group 4 At the first operation an intussusception was reduced and the causative tumor was found but was not removed at a second operation a recurring intussusception was resected with the tumor at third and fourth operations multiple tumors were removed or excluded.

It is clear that to a greater or lesser degree in these reported cases there was a failure on the part of the surgeon to understand clearly the relationship between tumor and intussusception. In one instance it was only after an intussusception had been reduced three times by laparotomy and twice by manipulation through the abdominal wall that at a fourth operation the true relation between tumor and intussusception was realized and a cure of both conditions was accomplished by resection.

The cause of intussusception has long intrigued the interest of clinical investigators. Three underlying factors have been proposed (1) perverted peristalsis (2) paralytic conditions of the bowel allowing prolapse (3) a lesion of the intestinal wall whether or not causing partial obstruction such as a tumor a diverticulum an ulcer or an inflammatory thickening.

The first two suggestions are vague and unsupported by satisfactory evidence. As Wardill remarks the bowel is expected to display suicidal tendencies for no apparent reason. It is true that at laparotomy under local anesthesia or in the experimental animal transient slight invaginations of the bowel are often noticed and also that similar conditions are found at autopsy but there is nothing to prove that these conditions are other than transient or agonal. On the other hand the third theory is abundantly supported by evidence from the literature. Kassemeyer states that in 84 cases of intussusception in adults tumors were present in 208 and appendices or diverticula were found in the remaining 46. Clifton and Landry tabulating 45 instances of fibromata of the intestine say that in 31 patients in whom the tumor was present in the lumen of the intestine intussusception was present in 29. Lhot and Corscaden say that of 300 cases of intussusception in adults 100 were associated with neoplasma and many others with ulcers or foreign bodies and inasmuch as tumors are so frequently overlooked it is probable that the proportion is much greater. Cases are reported of invagination of a Meckel's diverticulum causing intussusception (Lower) or a typhoid ulcer or a local thickening due to tuber

culosis The tumor or other lesion is almost invariably at the apex of the intussusceptum The mechanism probably represents the reaction of the intestine to the tumor as a foreign body which it attempts to expel A pedunculated tumor may be pictured as lying with its free extremity swept caudad with the fecal current A peristaltic wave approaches it from the cephalic direction and pushes it into the relaxed intestine beyond where it is gripped by successive rings of contraction which push it onward while the intestine now relaxed at the point of attachment is drawn after it permitting the growth of the invagination at the expense of the intussusciptions It is not difficult to picture the same process in the case of a massive ulcer or other mural infiltration It must be admitted however that in the presence of a tumor the intussusception sometimes may be at some little distance either proximal or distal suggesting that the new growth has caused to appear in its neighborhood an anomalous type of peristalsis Collier in reporting a remarkable case of this sort says There is no doubt that this woman had two adenomata and two intussusceptions along her intestine at the same time in order from above downward as follows intussusception adenoma intussusception adenoma

Objection will be at once raised that while the etiological factors suggested may account for intussusception in adults they are absent in the vastly more numerous instances in infancy and childhood It is well known that the lesion is more common in the first 2 years than in all subsequent years of life taken together and that it occurs as an invagination of the terminal ileum into the large bowel either through the ileocecal valve or with that structure acting as the apex No tumor or gross pathological lesion seems to play any part in this process—a fact which tends to discredit the etiological responsibility of these conditions in intussusception in older individuals Perrin and Lindsay however elaborating suggestions made by others call attention to the enormous development of the lymph follicles in the wall of the terminal ileum and about the ileocecal valve which reaches its maximum before the age of 2 and which is doubtless augmented in bulk by toxic absorption due to disturbances of intestinal digestion so common during the first years of life Thus the bowel wall at this point may become so massive as to constitute a tumor which may lead to intussusception in the same manner as does a true neoplasm in the adult If this view is accepted it places the etiology of most cases of intussusception on the same basis

In a review of the cases noted in this communication it becomes evident that the clinical picture of intussusception in the adult varies considerably from the conventional one which is based chiefly on the symptoms of the disease in infancy In the adult the attacks are irregularly recurrent often with long free intervals The symptoms are often mild consisting of colic like pain nausea sometimes vomiting but they may be more acute and characteristic of obstruction A tumor is frequently not noted but when present with visible peristalsis especially if the tumor subsequently disappears the picture is almost pathognomonic Gross blood is seldom noticed in the stools Such rather vague and inconclusive symptoms lead too often to ill considered operations for the removal of the appendix or fixation of the kidney or some meddling with the pelvic organs The true diagnosis may be suspected but cannot be confirmed because barium X ray studies cannot be made in the presence of acute symptoms and in the free intervals the scanty diffusion of the barium in the small bowel does not permit the tumor to be outlined

SUMMARY

From a study of this group of cases it seems possibly useful to formulate as follows certain suggestions for guidance in a field where the chances of a misstep are considerable

- 1 Among the possible causes of irregular attacks of colic like abdominal pain in adults without obvious etiology must be counted recurring intussusception

- 2 In patients with such symptoms to remove a suspected but innocent appearing appendix or to fix a harmlessly mobile kidney without careful examination of the intestinal tract is poor surgery

- 3 If an intussusception is found and reduced it is wise to assume that a tumor is present at the apex of the intussusceptum which should be removed

- 4 If no tumor is found in connection with the intussusception search should be made for one a short distance both proximally and distally

- 5 If a tumor is found without intussusception the intestine should be examined proximally and distally as another one may be present there

- 6 In any case of intussusception due to tumor the whole intestinal tract should be examined as thoroughly as possible since tumors are often multiple and may cause recurrent attacks

Every tumor of the intestinal tract especially if the tumor is situated within the lumen of the intestine no matter how benign the character

of the growth should be removed unless there is definite contra indication since it always carries the threat of intussusception

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ANATOMICAL SURVIVAL, GROWTH AND PHYSIOLOGICAL FUNCTION OF AN EPIPHYSEAL BONE TRANSPLANT

GEORGE F. STRAUB, M.D., F.A.C.S. HONOLULU, HAWAII

The Clin. II of I

If the epiphysis has been destroyed the bone will not grow in length from this implant at the point of epiphyseal absence unless an epiphysis is transplanted. I have not yet demonstrated that a transplanted epiphyseal line of young bone will become osteogenetic. In the next case that presents itself with an absent epiphysis I shall take the upper or lower end of the tibia with its epiphysis and transplant it because I feel that in young individuals it should become osteogenetic. This was written in 1911 by that resourceful surgeon John B. Murphy in a discussion of the subject of bone grafting.

One of the instances most liable to end with the destruction of an epiphysis is acute foudroyant osteomyelitis which has not received prompt treatment. With improving medical education fortunately such cases are bound to become a rarity. Of course since 1911 innumerable cases of osteomyelitic destruction of the shaft of bones have been successfully repaired by means of bone transplantation by various surgeons. In the field of bone grafting there is also a small number of cases on record in which entire joints have been transplanted with success. But in spite of these facts in the literature available to me I have not been able to find a case reported of successful transplantation of a piece of diaphysis with the epiphyseal line and a part of the epiphysis attached in which the epiphysis has survived grown and continued to function physiologically. From this fact I derive the justification to swell the already voluminous literature on bone grafting by the report of a case which on account of its continuous observation from 1911 to date has proved extraordinarily interesting and instructive. In passing I may say that the words of the eminent master quoted above furnished to me the stimulus for proceeding as I did in my attempt to re-establish anatomical relationship and function to the leg of the patient.

S. H. at the age of 4½ years in the beginning of November 1910 had severe pain in his left leg and high fever. The case was treated as rheumatism. When I saw the boy first on November 10 there could not be any doubt as to the diagnosis osteomyelitis acuta. Immediate operation was advised. The pus had in several places already broken through the cortex of the tibial shaft. The medullary cavity was thoroughly and extensively opened. The condi-

tion of the patient was very bad but improved gradually. Within weeks practically the entire lower half of the tibia including the epiphysis became sequestered. Then the wound started to granulate quickly and on December 1, 1910 the patient was discharged from the hospital with the entire cavity in healthy granulating condition. In another month (February 1911) the skin had healed.

At that time I had already advised the patient's father that later on probably a bone graft operation would have to be done but that this would not be possible until the leg had been free from any recurrent inflammation for a considerable length of time. Meanwhile we confined ourselves to combating the increasing deformity which on account of the continued growth of the fibula and the retardation of growth of the tibia finally reached a considerable degree with such inversion of the foot that the patient practically walked on the external malleolus. The x-ray taken on July 3, 1912 (Fig. 1b) shows this quite clearly. The frontal axis of the talus is tilted about 45 degrees with considerable inward rotation of the sagittal axis. The malleolar end of the fibula is about 3 centimeters lower than normal with reference to the talus. The radiogram also shows the result of the osteoblastic activity of the surviving periosteum. This had at that date come to a stand still. For all practical purposes we had here reached a final result which from the standpoint of weight bearing was entirely unsatisfactory.

Meanwhile (May 1912) I had read the above mentioned résumé of Murphy with the suggestion quoted. I decided that the case was an appropriate one for a trial of the method and after a consultation with the father of the boy obtained his permission to proceed with the experiment.

On October 5, 1912 the operation was done. The chief principles considered essential for success were first aseptic work, second careful preparation of the graft bed with the intent of obtaining as good a blood supply as could be had, third accurate apposition and firm fixation of the graft, fourth subjection of the epiphyseal line to good physiological pressure (Wolf's law) and fifth thorough immobilization of the ankle for a considerable length of time.

Operation. An incision was made about 12 centimeters long anterior to the old scar. The soft parts were lifted up *en masse* on both sides and all scar tissue in the neighborhood of the graft bed was thoroughly excised. The main spur of the tibia (Fig. 1b) was preserved while most of the bone situated medially was removed. The idea was to cut a good notch into the tibia for reception of the upper end of the graft and to vivify the remaining lower part of the tibial spur in order to obtain good lateral apposition for most of the length of the transplant (Fig. 3). In the process of preparing the graft bed in the lower part of the wound the greater part of the upper surface of the trochlea of the talus became exposed. The distance from the notch cut into the tibia to the talus was 10 centimeters.

Then a transplant was taken from the right tibia (Fig. 2) including the epiphyseal line and the internal malleolus. The piece was 13 centimeters long and was removed with blade saw and chisel in the fashion indicated in Figure 3. The periosteum was carefully preserved and some of the

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Fig. 1a

Fig. 1b

Fig. 1c

1 abducted about 45 degrees. There is a slight decrease of pes calcaneocavus and some atrophy of the entire left extremity. But motion and function are good.

Figures 3 and 14 show the condition described in Figure 1c more in detail.

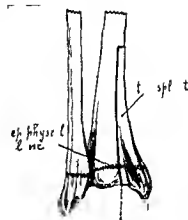


Fig. 3



Fig. 4

Fig. 5

Fig. 6

Fig. 7

Figure 15 is a photograph taken on September 3, 1935, 6 years after the operation. The patient is now working in the building trade. The function of the left leg is excellent. There is no pain or discomfort. The motion is good, although somewhat limited as far as flexion and extension of the ankle joint are concerned. The abduction of the foot with reference to the position of the patella is about 30 degrees less than 14 years ago. The tibia has kept on growing. The distance from the lower margin of the patella is 48 centimeters on the right and 43 centimeters on the left side. In other words, there is a difference of 5 centimeters as compared with 4.5 centimeters in 1914. The foot still is of a slight calcaneocavus type, although less so than 14 years before.

We have here a case of transplantation of a piece of bone including shaft, epiphyseal line and epiphysis which has been successful in so far as survival, growth and function of the epiphysis is concerned. After 16 years and the completion of growth of the individual, the present state in



Fig. 9

Fig. 10

Fig. 11

Fig. 12

TORTICOLLIS, REMOVAL IN EARLY LIFE OF THE FIBROUS MASS FROM THE STERNOMASTOID MUSCLE

H. H. ROY VON LACKUM, M.D., NEW YORK.

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THE etiology of congenital torticollis so called remains controversial. The first attempt at correction of the condition by open section of the sternomastoid muscle seems to have been made in 1641 by Isaac Minnus in Germany. Various theories as to cause have been suggested. The one receiving most support is that of intra-uterine position. It is not wholly satisfactory, however, because other muscles in the neck besides the sternomastoid should be more definitely involved with it or at least occasionally affected similarly.

That injury to the sternomastoid muscle during delivery occurs frequently is not denied. Whether the muscle in these cases was contracted before birth and for that reason injured at the time of delivery is not known. Siffel has reported torticollis in four patients in whom prenatal X-ray films showed a crowded position of the head. If the muscle had been contracted *in utero* it would seem that uninjured muscles of this type would appear more frequently. The theories advanced for such incidence include abnormal position resulting in ischæmia from involvement of the superior thyroid artery, infection, excessive nervous stimulation and an anomaly in the muscle blastema itself. Again it would seem that other muscles in the neck and elsewhere might occasionally show such lesions and that there should be more postpartum evidence to corroborate these theories.

Denial has been made that a ruptured or torn muscle specifically the sternomastoid contracts. There is evidence at the New York Orthopaedic Dispensary and Hospital and also from other clinics that contracture does take place though not always. That this phenomenon has not been noted in other muscles may be accounted for by the age and activity of the patient and by the fact that few other muscles are isolated anatomically to the same degree. The sternomastoid is isolated by its oblique and superficial position and by its unusually firm sheath throughout its entire length and circumference. The muscle is comparatively long and narrow. A scar in it especially in an infant might therefore produce a much more extensive contracture than would ordinarily be expected. The fact that injury does not always produce a contracted scar is perhaps explained by the extent of the injury and the physiological condi-

tions of repair. Not all scars in the skin develop a keloid.

The following cases are reported to show the actual conditions encountered in 4 infants having torticollis who were operated upon for the removal of masses from the sternomastoid muscle and to show the result of this removal. None of these cases was responding to the treatment of massage and manipulation usually relied on for infants.

CASE 1. F. K. N. Y. O. D. H. No. 93231. July, 1906. The patient a female was brought to the hospital when she was 5 weeks old. A history was given of a breech presentation and difficult delivery. A lump in the neck was noticed shortly after birth. The child held its head turned to the left and tilted to the right. In the middle of the right sternomastoid was a firm swelling about 1 inch by 4 inch. Movement of head to the right was very limited.

July 7, 1906. Through a linear incision the mass in the sternomastoid was exposed and found to be a tough fibrous point which extended entirely through the muscle and was sharply limited with the sheath. Torn muscle fibers were clearly evident at the upper and lower poles. The mass was removed and no attempt was made to close the gap in the muscle though the subcutaneous tissues were sutured to the bottom of the wound. No retentive apparatus was applied. The age was begun in 4 days.

February 9, 1907. Seven months after operation. The scar was well healed. There was no pain or tenderness. The child held her head straight and moved it freely in all directions. Some kind of continuity had apparently been established between the divided ends of the sternomastoid and the muscle was functioning although it was smaller and firmer than on the opposite side. It was of normal length.

June 3, 1908. Practically 3 years since operation. Movement of the head was perfectly free in all directions. The divided end of the sternomastoid had connected up and appeared to be functioning normally. No palpable evidence of fibrous tissue was found in its extent. No facial asymmetry or deformity and the ear was barely visible.

CASE 2. E. L. No. 94358. August 1906. The patient a female was brought to the hospital when 8 weeks old because of a lump noticed in the right side of the neck about 1 month after birth. Delivery had apparently been normal. The head was tilted moderately and movement to the left was highly limited. A firm swelling was palpated in the middle of the belly of the right sternomastoid muscle.

September 13, 1906. The child was operated upon in the well exposed position. The mass was found to be an area of thickened tissue extending entirely across the muscle and upward and downward though the muscle belly at a distance of about 1.5 cm. It was sharply limited to the muscle. A part of the mass 2.5 cm. was removed. No plaster was applied. The head was held in an erect position. A few days later the wound was healed. The wound healed well. At the end of 10 days the child herself held her head straight without support. The age was not begun for 1 month.

December 7, 1906. Child had full motion of the head in every direction.

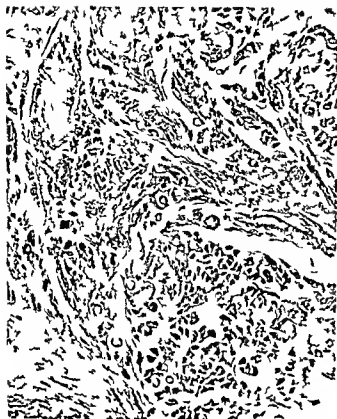


FIG. 3. Case 3. A.C. Low power photomicrograph showing the connective tissue and dense scar tissue which composed the mass removed at operation. Muscle fibers in cross section are seen singly and in groups scattered throughout the picture.

The head was held in normal position and was freely movable in all directions.

In going over these cases it will be noted that there was no abnormality of the surrounding musculature of the neck. When the sternomastoid was released practically full movement was possible. Also with the exception of one case the sternomastoid was apparently normal above and below the site of injury, though in the last case reported the scar ran into both divisions of insertion. In the one case the hemorrhage or injury had run up and down the entire length of the muscle, but in the other aspect had left what appeared to be normal muscle tissue. This condition is difficult to account for except by the fact that it was the oldest case and was definitely traumatic. Furthermore, the scarred part, as well as the normal, was limited by a normal appearing sheath. The latter had perhaps been torn with the muscle, but being fibrous tissue its repair had left it in good condition. On the other hand, an intact sheath may be the important factor, as by closely confining any hemorrhage which may have occurred absorption might be limited and a scar rather than good repair result. In 2 cases the mass was not noticed



FIG. 4. Case 3. A.C. High power of Figure 3. Note the homogeneous appearance of some muscle fibers and the presence of vacuoles in others indicating degeneration.

until a month after birth. This is evidence of contraction of the original traumatic mass, which was perhaps so widespread and soft that it escaped notice.

In all cases muscle tissue was distributed through the mass of scar, becoming more extensive as the muscle was approached at either end or on the side in the one instance. The fibers in the mass proper were degenerating apparently from pressure. Since operation, except for the slight post-operative scar, the muscle that remains has connected up in one way or another and is functioning in an approximately normal manner. This has been noted in older cases where a simple myotomy was done to correct the deformity. Whether or not the muscle was contracted *in utero* has not been determined. This seems doubtful because of the normal appearance of the uninjured portion.

Two of these cases, however, were apparently normal deliveries. They are sisters, and it is interesting to note that another child in this family, one of two brothers, also had a torticollis, which was associated with a mass in the side of his neck. There is said to have been no difficulty in his delivery. Correction was made at 9 months of age by simple myotomy and the result has been excellent. If these muscles were contracted *in utero*

RECONSTRUCTION OF THE HIP IN CASES OF IRREDUCIBLE DISLOCATIONS¹

WILFRED J. BUKA, M.D. PHILADELPHIA, PENNSYLVANIA

A NUMBER of methods are employed for the correction by open procedure of the irreducible dislocated hip but they will not be considered in this paper as they are fully described in the textbooks upon operative orthopedics. These methods have proved their great value to their originators but none of them has more fully and more thoroughly undertaken to achieve what nature has failed to accomplish than has the procedure to be described. To produce security of the unstable hip—to render it a walking and supporting part for the lower extremity—is a tremendous task for any orthopedic surgeon and finally to establish such a hip as a durable, painless and serviceable joint is the end result to which we aspire.

In developing the method to be described, I am indebted to Dr. A. Bruce Gill of Philadelphia. The systematic thorough technique embodied in this procedure is assurance of the soundness of the end result. Possibly it may be said that in this technique there is nothing new but it must be agreed that even if there be a meshing or dovetailing of methods the plan is what might well be classed as a systematic undertaking to be applied in the cases of hip dislocation that are to be corrected by the open method when reconstruction is the only choice.

While bloodless reduction might well be attempted in all cases of congenital hip dislocation it should not be considered after a certain period in the life of the patient. Up to a certain age or directly up to 10 years but not beyond that the method merits full consideration. There is an occasional exception to this age limit but in the great majority of the subjects beyond the tenth year more especially those previously unattended the method should not be considered with any great hope of success.

Attempt after attempt by means of this procedure may bring in a final effort the desired result—a reduced, painless and functioning hip. It is important however that we know when to discontinue our efforts. Only the milder manipulations should be used because even mild manipulations in bloodless reduction usually produce trauma and this is all the more true if extra force is used. Great caution must be exercised to avoid damage to the femoral head such as mashing, fragmentation or atrophy. If numerous attempts at bloodless re-

duction have proved unsatisfactory, no further consideration should be given this method. Bloodless reduction when unsuccessful may be thwarted by a pathological block and any hip presenting such a problem should be treated as a pathological dislocation.

INDICATIONS FOR RADICAL PROCEDURE

Reduction by the closed method should practically never be considered in diseased hips. Although occasionally the relaxed and paralyzed hip the result of anterior poliomyelitis may be reduced and maintained in position after many trials such hip joints are not truly pathological problems. Relaxation of the structures about the joint allows it to slip apart. No serious difficulties arising from trauma and proliferative changes need be solved in this group while attempts at reduction are being made. In these cases closed reduction is often very simple and maintenance in position by proper fixation brings about the occasional functional hip. As mentioned a functional hip is the occasional result of bloodless reduction but very often the result is a disappointment and a failure. Such failure brings recognition of the need for some open radical plan that will be the only solution for function and comfort in this group of hip dislocations.

The truly pathologically dislocated hip, the one which will not remain reduced or which cannot be reduced is a very big problem. The hip presenting a joint in which there are pathological changes, destructive, proliferative or both, should never be considered for correction by the bloodless method. It is useless. No class of the best nor patience of the utmost can satisfactorily establish a hip joint in a dislocated hip of this group. A hip with capsular or soft structural changes which fails to maintain a reduction in position should never be looked upon as reducible by other than the open procedure. Such hips should be considered for correction as soon as the age and development of the subject permit.

GENERAL CONSIDERATIONS

The satisfactory handling of this group of cases demands thorough knowledge of the anatomy and pathology of the site for correction. It is a big undertaking from the first inspection of the lesion to the day of the patient's discharge from the

physi therapeutic department. Every case is governed by its own requirements although there is a similarity in technique. The undertaking ends satisfactorily in the mind of the orthopedic surgeon only when it becomes an improvement in the mind of the subject. There is some flexibility in the age issue: the range of cases here considered being from 4 to 30 years. It varies with the general physical condition and development of the subject as well as the degree of pathology in the hip commanding attention. In this group of cases it becomes almost an axiom that the older the subject the more certainty there is of the arrest of any pathological process in the hip. Hence favored with an established pathology it becomes a surer workable proposition for the operator when he then is himself confronted with a dislocated hip for correction.

TYPES FOR OPERATION

In this paper we are confining ourselves to hips whether congenitally or pathologically dislocated which are considered the hopeless types for securing functional articulation between the head of the femur and the acetabulum *per se*. That is to say this reconstruction procedure is advocated where it is primarily realized that the acetabulum is gone or so nearly gone that a new one or an almost entirely new one must be constructed to receive the head or reconstructed head of the femur.

TECHNIQUE OF RECONSTRUCTION OPERATION

General aspects. In no way is it fully determined what details shall govern the particular procedure in a given case until the hip commanding attention is opened. The operator must allow himself to be guided with certain mechanical and physiological expectations always before him. Every case after operation requires most particular consideration immediately after incisional closure. Fixation is a very important issue when the patient leaves the operating room proper immobilization in a plaster of Paris cast being essential to ultimate success. Formidable as this whole undertaking may seem it is none the less simple when everything in the handling of this type of case becomes routine. The staff of nurses in the operating room arrange the particular armamentaria required. With the experienced orthopedist the average time consumed for the procedure should not exceed 90 minutes from the time of incision to the time when the patient leaves the table in immobilization. As the operation is of major character the matter of shock must not be overlooked. Convalescence generally goes to a favorable termination without complications.

Gross indications. The reconstruction operation is advocated for correction of irreducible dislocated congenital hips—the type which has beyond the hope of reduction even by the open method because of developmental changes due to growth and use of parts involved. The host of cases classed under the caption of pathological dislocations of the hip will also be discussed in brief consideration is given to that large group of cases in which the functionally impaired or the obliterated hip socket presents the problem of the construction of a new one.

Pathological indications. Pathological indications are to be found in ankylosis complete or incomplete in painful hips in hips dislocated through paralysis in hips causing a decidedly impaired and faulty gait in hips in which better position and range of motion are desired and in any of the combinations of these. When this plan is being considered active pathological processes in the hip must be ruled out. Most of the established processes have as etiological factors such problems as unsatisfactorily repaired or ununited fractures of the neck of the femur where union is no longer obtainable paralytic dislocation of the hip as from anterior poliomyelitis pathological dislocations or fractures which are the result of a destructive process such as tuberculosis osteomyelitis and hypertrophic arthritis. Further if it is desired to minimize suffering from local or referred pain and if ankylosis complete or incomplete in faulty position causes interference with weight bearing and gait the hip reconstruction procedure is indicated.

The hip trough. A box or trough is used for the patient to rest upon during the operation. This box was originally designed by Dr. Edwin F. Patton, former resident surgeon of the Philadelphia Orthopedic Hospital and further developed by the author. It does away with the constant annoyance occasioned by the adjustment of slipping sand pillows and it retains the patient at any desired angle from the horizontal plane to about 90 degrees. A description with photographs of this trough which can easily be built by a carpenter follows.

The patient is placed upon the bare trough before he is given the anesthetic and the draping is done after the patient is taken from the anesthetic room to the operating room where the preoperative sterile dressings are removed. A sterile paraffin sheet under a sterile muslin sheet is draped into the trough and under the patient. The trough rests upon the operating table in the direction of long axis to long axis. The trough and table are now ready for the draping. The hip

trough has the advantage that the field of operation is at a higher level than it would be ordinarily if the patient were placed directly upon the operating table. The patient is placed in the trough so that the back rests upon the broad side or base board while the well hip is upon the narrow side or vertical board away from the operator. The hip to be corrected is directly upward and before the eyes of the surgeon. A number of favorable and easy working angles from the horizontal plane of the operating table are available—a most desirable feature since the operating field may thus be brought from time to time into the operator's direct line of vision and working plane and ready access to the joint is thereby established. Thus when the crucial incision for the approach to the hip joint is made the operator sees readily as he cuts directly down upon the field.

Steps of operation. Ideally the Smith Petersen approach is the incision of choice. This may be in fact frequently modified for example the Sprengel encircling incision may be used. This incision fully follows the crest of the ilium forward and then it passes downward toward the great trochanter of the femur. An assistant takes hold of the foot of the extremity being operated upon and with varying movements for adduction abduction internal and external rotation assists in defining the joint capsule. The capsule is opened without fear of destruction of the ligamentous coverings and in order to obtain a full view of the head of the femur the entire obstructing portion of the capsule is cut away. The assistant continues the movements of the leg through the various arcs so that the operator gains further access between the head of the femur and what may have been the articulating surface of a remaining acetabulum. All ligamentous structures encountered during exposure of the joint may be freely separated in the manner which makes approach and enucleation of the femoral head easiest. It will be found that these structures are in the majority of instances of irreducible hips very much changed atrophied and distorted. In many cases they are simply remaining non functional attachments to the ilium and head or neck of the femur. Any partially or completely ankylosed joint surfaces of the hip should be chiseled apart.

After the pathological hip joint and the head of the femur have been explored the distortion and position of the latter which are the unfortunate accomplishment of weight bearing and other mechanical forces should be considered and the plan of possibilities for correction mapped out. If a fairly correct acetabulum accommodates a slipping head then the simple procedure of establish-

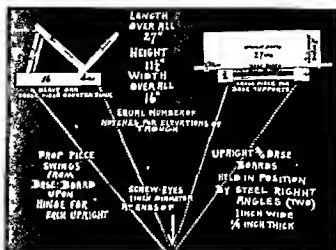


Fig. 1. Trough dimensions. Back supports 3 inch tubular at end attached support with hinges.

ing a check ledge to stop slipping in the commonest direction for dislocation is considered. If however the femoral head cannot be reduced then a new acetabulum at the site of lodgement of the head against the ilium is demanded. In any event the procedure for establishing a check ledge is necessary and its size depends upon the demand. Thus for a simple slipping head which dislocates in an upward backward or combination of both directions in fact in any direction a check ledge to stop this slipout from the acetabulum is necessary. This should be established in the location and at approximately the exact site out of which the head passes upon the ilium. If however the head cannot at any time or in any ordinary manner be brought down to where the original acetabulum should still be evident by means of X-ray it then becomes necessary to build a suitable check ledge or new acetabulum upon the iliac wing around the newly established socket or point of impact of the head of the femur against the ilium. The new socket should be constructed well anterior on the ilium. Drawings will serve to clarify the technique.

The autogenous bone wedge. In all cases of hip reconstruction done in accordance with Dr. Gill's method autogenous bone is used. From such chips are made to be used for wedges between the shelf of bone that shall function as a check ledge and the wing of the ilium from which the flap is lifted. As the check ledge or crown into or against which the head of the femur rests is turned down from the ilium its base or iliac attachment becomes that portion directly over or nearest the buttress point of the head of the femur. This is the only attachment which the check ledge has to the parent bone. The space between the check



A



B



C



D



E

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 d b k l d l n c t f
 hp B Sp e b t t l k l d
 d l c q l l q b l t e
 t d t b l m C G f t ()
 f m p l b m f l b t
 th b l k i d g l g f l m
 D Outl d l t x k l d f
 f t l l m l N t l
 l m h d o c k t
 f h l f f m G f t h p

le leg and the point from which it is swung away must be fully packed with autogenous bone chips. They are conveniently taken from any desired outer portion of the crest of the ilium. These grafts are chiseled off in quite large sections and divided or broken into pieces suitable for firm wedges that will keep the ledge or crown from turning back again toward its former seat in the ilium. After the check leg is solidly wedged

and the new or reconstructed acetabulum is firm with the head of the femur snugly resting against it, plans for closure follow. To close the wound the assistant must hold the extremity in the position which is best suited for cupping the head of the femur against the new acetabulum, thus being merely a newly formed buttress against which the head of the femur must jam for future weight bearing. The big problem after the completion of

the constructed hip joint is the maintenance of the head of the femur against the wedged ledge of the ilium which replaces the former socket into which the femur would have normally rested. The need of fixation for the making of this new joint begins immediately when the operator has finished with his last suture. With the operation field closed all coverings and drapes are removed. Frequently tenotomies for allowing any of the contracted musculature of the thigh which may be in flexion or adduction to relax become the necessary procedure in the course of the work toward the termination of the operation. Checking prevention of assuming the position of full extension and outward rotation of the affected extremity is not an unusual difficulty; it is due to shortened muscles of the adductor group and the sartorius. The fixation problem is an important issue.

Fixation and recumbency. Since recumbency with fixation is the immediate matter after the operation upon any such case this consideration is next in importance. Recumbency of the patient often requires the application of a fixation principle which is at variance with the ordinary problem of rest in bed. In fact, cases in some instances are placed in fixation where the hip operated upon requires the hanging of the extremity out of bed as at a right angle to the body in full abduction and internal rotation. Others are placed in fixation with the hip in hyperextension inversion and with only slight flexion at the knee. Such positions are for the purpose of maintaining the head in the newly constructed acetabulum. Reduction can be obtained only by a combination of any of the normal movements of the head of the femur in a normal acetabulum. Maintenance of position must therefore be obtained with recumbency after hip reconstruction and it must be secured regardless of position of extremity with its relation to the horizontal plane of the body.

Casts vary with the type of case but it is important to realize the necessity of building the cast high upon the trunk. It is safe to place such fixation almost to the level of the nipples and down upon the extremity to meet the various needs for fixation. Thus little or no mobility occurs in the immediate field of operation and this is all the more effectively accomplished when the cast passes well down upon the extremity involved in the correction. The body cast may extend down the leg as far as the knee below the knee or down to and including the toes. The length varies according to the demand for proper position for immobilization.

The cast is worn for 6 weeks after which the leg is immediately prepared for the application of ex-

tension and weights. Buck's extension apparatus is applied upon the leg 24 to 48 hours after removal of the cast and is heavily although comfortably weighted. While the leg is in the cast repair is the only matter to be desired and for this there need be little concern.

REHABILITATION

Promptly after the cast is removed and while the extension apparatus and weights are still in use the physiotherapist commences treatment to recondition the hip and entire extremity. Manipulations for short periods daily begin at once. The normal ranges of motion are attempted for longer periods each day as the patient's particular condition will permit. The weighting is continued except during the massage and manipulative periods for 4 weeks. For weeks more the weights are retained only at night. The patient is encouraged to do all active movements at any time after the physiotherapist has begun manipulations. Weight bearing is forbidden with or without support at this time. At the end of 6 more weeks the patient may go about on crutches wearing a high elevated shoe on the foot of the unoperated extremity. For the hip and leg operated upon a single bar pelvic band thigh brace is applied down to the knee. The elevated shoe is discarded from the opposite foot about 4 weeks following its adoption. Full weight bearing with supporting brace is allowed from 6 to 8 weeks after patient begins going about on crutches. In other words the patient walks around with the use of the brace about 18 weeks after the operation. The wearing of the brace is continued for a further variable period of from 6 to 8 months from the day of operation upon the hip. Massage and passive movement are wisely continued even after the brace is discarded. The latter recommendation is made upon the basis of the value of exercise for any weakened part.

SUMMARY

In summarizing this subject the following facts are brought forward with the view of stressing the desired possibilities when the procedures here presented are properly followed.

1. Bloodless reduction of the congenitally dislocated hip is definitely limited. When this is passed the method of open reduction is a definite solution and it is being increasingly adopted.

2. Pathological hip dislocations should be considered for correction only by the reconstruction method.

3. Hip reconstruction is a definite possibility for producing a stable, painless and weight bearing extremity with comfort to the patient.

4. The plan of reconstruction devised by Dr. Callender is a most carefully detailed one, and the only one which permits much attention when properly undertaken.

The possibility of establishing a check led or crown which in reality means a new acetabulum solve the problem of the irreducible painful and completely or partially ankylosed hip.

THE AIR OF INCISIONAL HERNIA

CLAUDE DIXON, M.D., M.S., JACOB K. L. K. M. F.

During a recent abdominal operation, the late American surgeon made the remark that he hoped the patient would be cured of his hernia. After the operation, he was asked why he made the statement. He replied that if incisional hernia did not follow, then the patient had recovered.

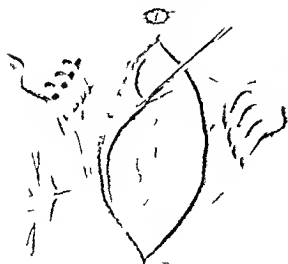
It is surprising to find that incisional hernia is usually not considered a hazardous surgical problem unless the hernia is large. There are many instances where the development of such hernias and many other abdominal incisions are made without them. Of course, one is prone to the development of postoperative hernia and the risk factor is the left is high.

The most common postoperative complications from this type of operation are ileus and peritonitis. The replacement into the abdominal cavity of the large mass consisting of omentum

and intestines may increase the intra-abdominal tension to a point beyond endurance, resulting in ileus with the possibility of peritonitis.

It has been observed that patients suffering from postoperative hernia may be operated on with minimal risk if they are put at complete rest for several days prior to operation. The purpose of this is twofold: (1) since the abdominal muscles are used little during this period of rest, they lose their tone and become more elastic and (2) the weight can be easily reduced. These two factors permit more stretching of the tissues and thereby not so marked an increase in abdominal tension as occurs if the operation is performed without preparation of the patient.

In almost every case of incisional hernia, an entanglement of intestine and omentum is adherent to the wall of the hernia. Careful dissection and replacement require time in addition to the possibility of ileus, peritonitis and occasionally



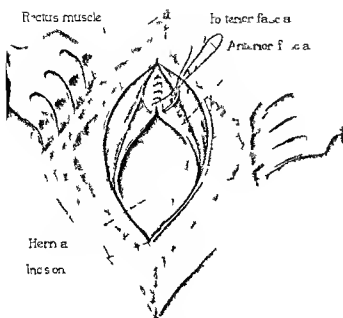


FIG. 3. Inversion of fascia by means of running suture.

hæmorrhage. The procedure suggested here has been used in several cases with uniformly good results.

A rather wide incision is made in the skin and is carried down to the fascia. The edge of the area of skin to be removed is then grasped with forceps (Fig. 1). Traction is made while the dissection is directed to the hernial mass. Great care is exercised not to injure the intestine and if possible the peritoneal cavity is not opened. If a small opening is made it is immediately closed by plain catgut sutures (Fig. 2).

After the hernia is bared (Fig. 3) an incision is made in the anterior fascia about 0.5 centimeter from its margin extending throughout its circumference. The edges of this narrow margin of fascia are then approximated by means of a running suture (Fig. 3). By this procedure the protruding intestines and omentum are replaced in the abdominal cavity. The adhesions have not been disturbed and the peritoneal cavity has been only slightly opened if at all. The anterior fascia is then overlapped (Fig. 4) by means of interrupted or running mattress sutures. Near the approximation of the two fascial layers a single running suture is used to prevent the possibility of small bits of fat work-



FIG. 4. Overlapping and closure of anterior fascia.

ing between the fascial layers. The edge of the fascia which has been overlapped is then sutured to its underlying portion.

SUMMARY

This method is suggested because it affords repair with a minimum of trauma to the intestines and omentum and decreases the chance of ileus and peritonitis which are fairly common complications following repair of the incisional hernia.

Intestinal obstruction occurs occasionally as a result of postoperative or incisional hernia but is usually the result of a loop of intestine finding its way out into the hernial sac.

It has been found that patients suffering from incisional hernia are more likely to have an uneventful convalescence if they are prepared for operation by being kept at complete rest for several days.

This method of repair of incisional or postoperative hernia has been used in many cases with excellent results and without fatalities.

REPORT OF THREE CASES

JAMES C. MASSON, M.B.(F.) MD, FACS, KACL & TEL. ME. TA.
1. 1. Th. M. Cl.

A'D

NORMAN C. DOCHSNIERKT M.D. IITT CR P

F. H. Th. 1. F. 1. R. h. M.

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FIG. 1. Dermoid cyst of the ovary with squamous cell carcinoma arising in the cyst shown at the lower pole of the dermoid cyst.



FIG. 2. Squamous cell carcinoma graded 3 arising in a dermoid cyst of the ovary. The irregular cell masses penetrated the connective tissue stroma with papilla-like projections (X 600).

and surrounded by connective tissue and penetrated the connective tissue stroma with papilla-like projection (FIG. 2). In some sections the carcinomatous process could be seen arising from the normal squamous epithelium which lined the cyst. There were scattered pearly bodies throughout and one section showed dense masses of cells with numerous pearly bodies. The size of this nodular area was 9 by 4 by 4 centimeters. The final diagnosis was squamous cell epithelioma, graded 3 in an ovarian dermoid cyst.

CASE 2. The patient, aged 48 years, came for consultation because of abdominal pain. She had six children all of whom were living and well. She had been well until January 1917, when she began to complain of intermittent soreness extending down from the umbilicus to the middle of the abdomen. The soreness had no relation to food nor was it relieved by food or soda. The patient had been compelled to use cathartics for the last 5 years for constipation. She had been troubled with weakness, anorexia and loss of strength for months and had lost 35 pounds. At intervals for several years she had had nocturia two or three times every night.

The systolic blood pressure was 100, the diastolic 66. The pulse was 120, the temperature 101.4. The patient was rather thin and the skin was lemon yellow. A large hard tumor, some what movable, extended from the pelvis to the umbilicus and seemed to be attached to the uterus. There was edema in both legs, graded 3. The hemoglobin was 29 per cent. Erythrocyte number 1,930,000 and leucocytes 11,800. Differential count was 300 polymorphonuclear leucocytes were 73 per cent, small lymphocytes 13 per cent, large lymphocytes 9 per cent, eosinophils 0.7 per cent, neutrophils 1.0 per cent, and monocytes 1.2 per cent. There was slight anisocytosis. The Wassermann test was negative. Roentgenograms of the chest showed the heart to be enlarged and to the right. Probable malignant pelvic tumor was diagnosed.

A transfusion of 250 cubic centimeters of whole blood by the ordinary citrate method was given September 10, 1917. September 1, 500 cubic centimeters of whole blood was given. September 2, 500 cubic centimeters and October 7, 750 cubic centimeters. The hemoglobin was 54 per cent. The erythrocytes numbered 45,000.

October 5, 1917, operation was performed through a low midline incision. The abdomen was filled with ascitic fluid. The ovaries were dense adhesions which made exploration of the upper part of the abdomen impossible. Nodular dermoid cyst of the right ovary was found. The largest of the area about 4 centimeters in diameter and appeared to be malignant. It had perforated and involved the small intestine. The right tube and ovary were removed and resection of about 30 centimeters of small intestine was necessary. Intensive roentgen ray and radium treatments were given.

The patient returned December 17, complaining of a mass at the base of the abdominal incision. This was removed and found to be malignant. The patient died March 8, 1918 at her home. Necropsy was not performed.

Section through the malignant portion of the tumor showed large irregular polyhedral and cuboidal cells with large nuclei. Mitotic figures were seen. There were numerous irregular cell nests surrounded by connective tissue and alveolar papillary projections on the connective tissue in the stroma and in the numerous pearly bodies.

Adagnosis of squamous cell carcinoma in a dermoid cyst of the ovary was made (FIG. 3).

CASE 3. A woman aged 67 years came for examination because of a swelling in the abdomen. She had six children and one miscarriage. The menopause had occurred at the age of 35. For the last 4 months she had noticed the progressive enlargement of the abdomen associated with burning pain in the lower right quadrant. For the last 8 or 10 years she had had stomach trouble characterized by distention after eating a feeling of heaviness in the abdomen and much belching.

The patient was rather slender. The abdomen was large. The heart was slightly enlarged on the left border 15 centimeters from the midline in the fifth interspace. A low inguinal hernia was transmitted to the axilla. A large hard tumor completely filled the abdomen and reached almost midway between the umbilicus and tetrurn. The cervix was ulcerated and eroded a cervical polyp protruded. The uterus was normal in size. The examination was rather unsatisfactory because the tumor filled the pelvis and abdomen. The pelvic rigidity of the uterus was increased and was acid.



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COMMENT

All of the cases reported in the literature could not be accepted as squamous cell carcinoma arising in a dermoid cyst of the ovary. Some of the cases were rejected because of the too meager microscopic description of the specimen, some because of failure on the part of the author to state definitely the origin of the carcinoma. Others were rejected because they were frankly not cases of carcinoma. The cases rejected were those reported by Heschl, Jommier, Flax, Chlen, Babinski, Wahl, Carter, Cohn, Pottien, Seeger, Pomorski, Shoemaker, Souligoux, Morison, Wilms, Geyer, le blanc, Wood, Vermet, Krecke, Lauro, Chavannaz, Gebhard (first and third cases), Newmann, Wittauer, Backhaus, Kehrer, Pomje van

Meerdervoort, Ihedener, Clement, Peterson, Benjamin, Hicks, and Targett, Norris, Dudgeon, Brettauer, Grant, Menestrina, Shaw, Franck, Nadal, and Lacouture, Boyer, Hellier, and Stewart, Stewart, and Eglington, Kloss, Lapouge, Frank, Bab, Spalding, Potherat, and Potherat, Frankl, and Isenstaedter (first and third cases), Ewald, Paguet, Falk, Falkner, Ahautz, Keitler, Kraemer, and Oliver.

The clinical differentiation of benign dermoid cyst of the ovary and dermoid cyst of the ovary with malignant degeneration is almost impossible. The earlier stages of malignant degeneration arising in a dermoid cyst cannot be diagnosed. However, if the carcinoma has advanced so that it has penetrated the wall of the cyst or has given rise to palpable metastatic nodules in the adjacent organs, the tentative diagnosis of malignancy in a dermoid cyst might be made if it is associated with a history of an abdominal tumor of long duration or with the history of recent rapid growth in the tumor associated with pain and a general loss of weight and strength.

In this series of cases the longest duration of the presence of tumor was 19 years and the shortest 6 weeks. Malignant change in a dermoid cyst of the ovary usually appears as a few areas of vegetation on the internal lining of the cyst or as a simple thickening of the cyst wall.

The diagnosis can be made usually only by careful microscopic examination of the cyst after removal and often malignant changes may escape notice. Malignant changes have been shown to occur in from 0.5 to 5 per cent of cases of dermoid cyst of the ovary, and it is probable that if careful

CASES FROM THE HITALAULI

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CASES FROM THE LITERATURE—C 1 d

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pathological examination was made as a routine the percentage of cases in which malignant degeneration is known to occur might be even larger this should result in more careful pathological study of such tumors

The age at which this complication arises appears to follow the same general rule as malignancy in other regions The youngest patient noted in literature was 20 and the oldest 66 The average age at which the complication arose was 49 years 40 per cent of the cases occurred between the age of 40 and 50 and 5 per cent of the cases between the ages of 50 and 60

The prognosis in these cases is grave rarely do patients recover completely In the series of cases reported in the literature the result was recorded in eighteen In each case death occurred from within a few days after operation to within 2 years

from recurrence with the exception of the case reported by Lapouge in which the patient lived 7 years and then died from recurrence in the abdomen Ludwig reported the case of a patient who was well at the end of 2 years but further report was not given

In our three cases one patient recovered uneventfully and has not been heard from since the operation One died 5 months after operation from recurrence and the third patient was well at the end of 5 years

SUMMARY

Squamous cell carcinoma arising in a dermoid cyst of the ovary is not common occurring in from 0.5 to 5 per cent of the cases Thirty three cases of squamous cell carcinoma arising from dermoid cyst of the ovary were reviewed from the

literature and three new cases added. The clinical differentiation of degeneration of the dermoid cyst of the ovary is practically impossible until the later stages. Microscopic examination is the only certain method of diagnosis. Every dermoid cyst of the ovary should be carefully examined microscopically for malignant change. The prognosis is grave unless the cyst is removed early. Exploration should be performed in every case of tumor of the ovary unless there is absolute certainty as to its nature.

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Interior colpohysterotomy (Spinelli operation) The technique of the operation was exactly that quoted in Case 2 with the exception that no iodoform gauze was in the vagina. The patient left the table in fairly good condition.

The patient ran a septic course for 4 weeks following operation the temperature ranging from 104.6 degrees F to normal the pulse ranging from 144 to 76 and the respirations from 50 to 20. On April 7 1927 the second day after operation a citrate transfusion was performed 800 cubic centimeters of blood being administered. On the fourth day after operation the posterior vaginal drain was removed and on the seventh day the anterior vaginal drain. The patient had several chills during the first month following operation and although the temperature rose each night to the vicinity of 104 degrees F her pulse very seldom went above 100. The transfusion incision in the arm became septic and for a number of days pus exuded freely from that region. This readily cleared up however under Dakin's dressings. Several pelvic examinations were made as it was felt that an abscess might be developing in the pelvis nothing abnormal was found pelvically at any time. The incisions in the uterus and the drainage tracts in the vagina healed by first intention and caused no disturbance. The patient always looked fairly well despite the fact that she had a high temperature. She was discharged on May 29 1927 34 days after operation. At that time the examination revealed the following: The perineum was well healed the vaginal incisions and drainage tracts were well healed the uterus was in second degree retroversion and movable the adnexa were normal there

were no masses or areas of tenderness in the pelvis. The patient has continued to improve since her return home. In October 1928 her family physician stated that she is in good health and had no pelvic disturbances.

SUMMARY

Uterine inversion of the uterus is a rare condition the predisposing causes of which are uterine inertia pressure on the fundus from above and traction on the cord from below. Shock is the leading symptom and when this occurs after the third stage of labor uterine inversion should always be borne in mind. In acute cases the uterus should be reinverted manually when possible as soon as the condition is discovered. In cases in which this is not possible laparotomy and reposition by taxis seem to give the best results. Chronic inversion is well treated by the vaginal method anterior colpohysterotomy (Spinelli operation) when the uterus can be saved vaginal hysterectomy when the opposite obtains. The shock should be combated by blood transfusions before attempting the operative procedures. The obstetric future of a woman who has had a Spinelli operation should be that of one delivered by a previous classical cesarean section.

CORRESPONDENCE

THE BILLROTH I RESECTION OF THE STOMACH

Dr Victor Orator the author of "The Billroth I Resection of the Stomach" which was published in the Department of Clinical Surgery of the September 1928 issue of SURGERY GYNECOLOGY AND OBSTETRICS has asked the Editor to call attention to the fact that Figure 3 as published illustrates the

end to side modification of the Billroth technique (Haberer Moynihan). Illustrations as published were drawings made from photographs which were submitted with the article and the author had no opportunity to examine the drawings before the publication of the article. Dr Orator does not believe that Figure 3 accurately represents the facts. Unfortunately these corrections have of necessity been delayed.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

I H M M D M g E I t
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MAY 19 9

TUBO OVARIAN DISEASE

WITH reference to tubo ovarian disease Doctor William J Mayo remarked recently that the case had been argued ever since he had been in surgical work. Yet effort at formulating the present status of the treatment have their value however much the points of view may vary. We reach agreement in actual cases more readily than in the abstract. This is quite in contrast to diplomacy with its apparent ease of agreement in principle but disagreement in concrete problems.

The most important method we have in medicine of determining what is best in treatment is the objective statistical study of a large series of cases especially with reference to a prolonged follow up study. It is recognized that the statistical method is not entirely without criticism. This is because of the necessity of recording each individual case in final tabulation of more or less inflexible character. It would be unfortunate if the method should tend to fix the deplorable custom of the use of the word "case" in the sense of seeming to overshadow the individuality of the patient and his particular ail-

ment. That this is not always so and that the shortcomings inherent in the method of statistics is recognized is indicated by the desire frequently noted of amplifying the report by discussion of some of the cases in detail citing those elements which did not lend themselves well to tabulation. In a further sense all this is acknowledgment of the importance of the method of an older day of deriving general principles by drawing them out of a deep thoughtful consideration of striking experiences in individual instance. Artistic interpretation has ever been quite subjective in its method.

The following is in summation of still another attempt to state principles bearing on the treatment of tubo ovarian disease.

1 Acute tubo ovarian disease does not demand surgery unless a large pelvic abscess has formed.

2 Pelvic abscess is the only common dangerous complication of both acute and chronic disease of the uterine adnexa.

3 Pelvic abscess is best treated by vaginal puncture in the posterior fornix and the institution of drainage.

4 Acute tubal infection may subside so completely at times as to be looked upon as a self limited disease.

5 In chronic pelvic inflammatory disease occasionally even large pelvic masses probably due largely to adhesions may disappear.

6 Chronic tubo ovarian lesions are peculiarly liable to acute exacerbations and the recrudescences or reinfections in themselves should not be considered surgical while in the stage of fever and leucocytosis unless there is abscess formation.

7 However operation in certain cases is justifiable when there is a suspicion of appendicitis. Then operation is so urgently indicated that it outweighs its doubtful value in cases of simple tubo ovarian disease.

8 In those cases of chronic pelvic inflammatory disease leading to prolonged invalidism operation becomes definitely indicated. It should consist of radical surgery usually of bilateral character. As a rule conservation of the ovaries or of portions of them and even of the uterus is of doubtful value. Yet leaving the cervix seems to be the proper course. Complete quiescence of the disease is indicated by prolonged absence of fever and leucocytosis is extremely desirable and the criterion of safe surgery.

Finally as the disease of itself has a relatively low mortality its treatment demands methods which should have no mortality. The attempts at justifying dangerous treatment on the ground of the difficult economic status of the patient is scarcely warranted. Surgery and economics should not be confused. Ward cases sometimes lead to this doubtful type of reasoning. Private work with its more intimate acquaintance with the patient and the family leads to sounder views on this subject. A single misfortune in private practice compels more regrets than can be wiped out by a high percentage of good results in general.

CHARLES W. HINNINGTON

VALUE OF RECTAL TUBE IN OPERATIONS FOR ACUTE ABDOMINAL CONDITIONS

TO obtain an evacuation of the bowels the day after operation for diffuse septic peritonitis is often a matter of great importance and concern. After an experience extending over many years I feel confident in advising the use of a colon tube put into place during an abdominal operation to accomplish

this purpose. I feel that it is just as valuable and important as the stomach tube has been proven to be in preventing death from gastric dilatation. In a considerable number of cases of paralytic ileus it will prevent over distention of the intestines. It should be used in all cases of peritonitis from whatever cause in all case of intestinal obstruction whether mechanical or paralytic and in many operations upon the female pelvic organs to prevent adhesions to the small bowel or omentum.

A colon tube 3 inches long with an eye at the middle as well as at the end passed with a cork screw motion by an assistant or nurse can be guided by the surgeon with his hand in the abdomen past the tricky rectum and through the sigmoid to the splenic flexure or higher. It will then be seen how difficult or impossible it is without such help to pass a rectal tube up to or beyond the sigmoid. It almost invariably becomes arrested at a point 4 inches above the anus and then bends on itself and doubles up within the rectum. The tube should be passed well above the sigmoid and as far as the splenic flexure so as to remain in position. It should then be secured by a suture to the skin about the anus and can be left from 4 to 6 days as occasion requires.

The chief benefits to be derived from its use are first it permits of an easy escape of gas and prevents distention of the large bowel second by holding the sigmoid flexure and the mesosigmoid across the brim of the pelvis it forms an effectual shelf which prevents the small intestine from falling into the pelvis third it enables one to administer saline and glucose high up into the colon where it will have a better chance of being absorbed and also will enable one to give enemata where they will be most effective. Should the bowel become irritated by the tube and it occasionally does a warm oil enema will relieve it.

HERBERT A. BRUCE

MASTER SURGEONS OF AMERICA

ELISHA H GREGORY

On Sunday February 11 1906 there passed away at Ormond Florida at the age of eighty two years Dr Elisha H Gregory for more than fifty years a resident and surgeon of St Louis

Dr Gregory was born in Kentucky of parents descended from old Virginian stock and the period of his education antedated that prescribed by Oliver Wendell Holmes for that of a gentleman His seventeenth year found him living with his parents in a northern Missouri town apprentice to a printer and studying medicine from borrowed books at the same time Two years later he attended a course of lectures in Louisville and shortly after his return he was married to the life companion with whom many of us were acquainted

The doctor's early efforts in the city were marked by the same energy which he had displayed in the country and success came early He made but one effort for a political appointment and afterward commented many times upon the ultimate failure of the more successful candidate In the days when to be a surgeon meant more than the possession of a little technical skill such talent and energy as his brought him rapidly to the front

The doctor was justly proud of his success While it had its foundation in well regulated energy directed toward good this simple man had many special qualities that added greatly to it First and foremost he seldom made a mistake in the estimation of a man's worth and while he was sometimes tolerant beyond the limits of charity I have seldom seen him misplace a trust He had a trick of knowing when to act without asking questions which besides constantly saving him much time was responsible for his surgeonship in the Mulhenny Hospital Another habit to which he himself attributed much of his success was his ability to be on time for all his engagements and he considered his meals not the least of these Physically he was not a strong man but the habit of care which this engendered is probably responsible for the length of his useful life It was the doctor's wont to refer to himself as unsophisticated but he who acted on this idea was liable to make grave mistakes

In questions of medical ethics he was almost always on the right if not always on the successful side and his policy was seldom been questioned For years as a medical expert he was held in the greatest esteem a terror to the



ELISHA H GREGORY
1824-1906

evildoer but more often a Godsend to the well intentioned medical brother who had been placed in a false or questionable position. He placed justice higher than friendship by which he at times incurred ill advised criticism.

I think his greatest talent was for teaching or at any rate I am sure he was the greatest medical lecturer we have had. Here his concise knowledge, his pure logic and his enthusiastic love of his subject combined in an effect that carried away both himself and his listeners yet he has often said that he was extremely diffident about speaking in public and always avoided it when he could. This was not true about lecturing to medical students. He understood them and felt that they understood him. He liked to talk to them and he put in his best work in the preparation of these lectures. He knew and loved each of his students followed their careers with intense interest and took the greatest pride in their success—and was given real pain by their occasional failures. There is no doubt that his teaching and working for the medical students was his greatest pleasure outside of his domestic life. He taught in the St. Louis Medical College and the Medical Department of the Washington University for fifty years when he resigned it was with the protestations of his associates and students in the full possession of his powers and faculties.

Next to his students he loved his books. Not all books nor many books but those that tried to deal honestly with Nature in any of its phases either of mind or matter. He had an excellent library most of the books were interlined and annotated by himself and next to those whom he considered the masters of medicine his favorite author was Shakespeare.

Of the number of offices that came to him I would mention just two. It was many years ago while on the City Board of Health that he succeeded in having the medical management of the City Hospital taken from political control—to which condition it has unfortunately since relapsed and St. Louis once had the honor of seeing him president of the American Medical Association.

Dr. Gregory was essentially a surgeon, a safe operator and an exponent of that greater surgery that recognizes Nature as the Master, a master not to be insulted by ill advised interference. He operated unhesitatingly when he judged it necessary but when there was a question he gave the patient the benefit of the doubt and waited a little longer. He hated mutilation of the human body to the point of passion and never did more than was necessary. Though he looked upon the advent of antiseptic surgery with much the same emotions as must have come to the patriarch of old when he gazed upon the promised land still never an enthusiastic operator the antiseptic technique possibly because untrue was irksome to him and before many years he began slowly but surely to withdraw from active practice. Every minute gained in this way was devoted to study unhampered by the distractions of practice until in his old age he was marching along in front of the procession of knowledge.

The great engrossing study of his life to which the latter years were entirely devoted was the subject of inflammation. With the older surgeons he had known it in all its forms and in all its manifestations and yet as to its cause and its underlying processes for the greater part of his life he could but guess. Can it then excite wonder if after spending two thirds of his life working in the dark when Pasteur and Virchow and other such luminaries did add their light to his he should have chosen to stop to gaze on and to revel in the illuminated landscape which his efforts had helped to light up and with which he had become familiar while groping in the twilight of dawn? His address as president of the American Medical Association was at the time hardly accepted yet today it contains but mere commonplace facts while his final paper on Inflammation showed that he still maintained his advanced position.

There will be many tributes to his memory but none will be given with more sincerity than this—that he was a simple man leading a simple life seeking truth for its own sake and doing good because it was right. A. P. BLAIR



THE SURGEON'S LIBRARY

OLD MASTERS IN SURGERY

WILLIAM BROWN AND JACOB OWENS, NEBRASKA

THE PROPHETIC VERB ON THE USE OF THE CAUTERY

CAUTERIZATION represents one of the oldest of healing methods. Why this is so we cannot surmise but speculation is interesting in this case seems to lead to a conclusion which is at any rate tenable. As far back as records go the four elements recognized were earth, air, water, and fire. Of these the last fire was the most mysterious and it appeared only occasionally, spring from nowhere and vanished into space, going apparently to the place whence it came—nowhere. With the recognition of the method of starting fire and method of keeping it under control it was found to be the great purifier and extremely useful in destroying material either harmful or no longer of use. We may imagine that as the methods of control became more efficacious and the fact was appreciated that fire transmitted its qualities to materials placed in contact with it the idea filtered into the mind of our early ancestors that if this element would destroy harmful and noxious substances outside the body why would it not destroy the same things if present on the body, such as dirty wounds, ulcers, and various growths? If this was the first step the amplification of its use was obvious and can be followed without great difficulty.

Whether the above approximates the true development or not the fact remains that the cautery became early firmly fixed in the surgical mind as a most efficacious and we may judge for certain things the most efficacious method of treatment. The aphorism of the fire is found in the ancient writings of different races. In the Hindu surgery it appears as "The fire cures diseases which cannot be cured by physic, the knife and drugs." *Aschelus* in his *Isgimmon* introduces the aphorism when he says "What is lacking in the physician and drugs I will then destroy utterly with the knife and fire." Hippocrates says much the same in his eighty-seventh aphorism: *Quæ medicamenta non sanant ea ferrum sanat quæ ferrum non sanat ea ignis sanat quæ vero ignis non sanat ea insanabiliter reputare oportet.* What medicines cure not that iron (the knife?) cures what iron cures not that fire cures what even fire cures not that must be considered incurable.

Hippocrates used the cautery for almost everything even to the attempted cure of recurrent dis-

location of the shoulder in which he burned the nail with the steel of forming cartilage which ultimately at the head of the humerus from leaving the glenoid. Evidently more and more uses were discovered and the reference to the cautery and its indication in form of the instrument to be employed kept more and more space in surgical literature. Following Hippocrates, *Aretæus* of Capadocia (A.D. 30-90) used the cautery in pleurisy and many other diseases. Soon after the introduction of the actual cautery another element than form of instrument entered and we find long discussions as to the material of which the instrument is to be made. *Aretæus* for example advocated the use of iron and we proceed along the line through the Byzantine surgeons and reach the Arabian School where we come upon the great *Albucasis* who advocates iron, silver, gold, and brass cauteries and lays down definite limitations for the use of each. He in turn was followed by *William of Salicet* and *Cuy de Chivalrie*, both great believers in the cautery.

By the sixteenth century the cautery had so far taken its place as a standard therapeutic item in surgical practice that it is mentioned by the wound surgeon only in praising its efficacy being taken for granted by *Brunschwig von Cerssdorff* and the later wound surgeons of Europe. Then with the advent of *Lara*, the bombshell burst and the throne upon which the cautery had been so firmly seated for so long seemed to be tottering. The idol had been attacked and it was only natural that its votaries should come to its aid. Consequently at this time one finds special treatises devoted to the cautery, the most important being those of *von Cavassetti* (1584), *Magni* (1588), *Costeo* (1595), *Ijens* (1601), and *Bartholinus* (1624).

The Discourse of *Pietro Paolo Magni* of Piacenza—Concerning the method of using the cautery in lesions of the human body, etc.—was published in Rome in 1588. Of its author *Magni* little is known except that he was a friend of Cardinal *Farnese* to whom he dedicates his book. His three friends, *A. Q. I.* *Joseph Castelfio* and *Celsus Cittadinus* who wrote the dedicatory poems are apparently not men of prominence and tell us nothing of the author who appears in the portrait woodcut as a fine looking man whose arms carry the motto "With strength they do not fail." The volume most perfectly placed as one of the important compilations of the uses of the cautery by a practically unknown author.

mors which have been studied in Dr Cushing clinic. This time the authors are concerned with the blood vessel tumors of the brain 29 examples of which have occurred among 15 histologically verified intracranial tumors. These 29 tumors have been further divided into the angiomatous malformation and the angioblastoma or true neoplasms arising from blood vessel elements. Among the latter are included the recognized examples of Ludwig disease.

The study of these tumors is presented in a manner which is suggestive of it having been done in a matter of record more than anything else. Therefore it seems to lack the certain charm which one has been led to expect from the monographic report which come from the Brigham Hospital clinic. The letter spacing style of emphasis is a bit annoying to the reader and does not lend itself to make an attractive printed page.

LOYAL DAVIS

ONE of the monographs of the Mayo Clinic series *Thrombo Angitis Obliterans* is written by men who have attempted to penetrate the maze of symptoms presented by vascular diseases of the extremities. The book gives one the impression that it is the result of their attempts to bring order out of chaos in their own minds concerning these conditions. Consequently it is much more valuable than some others we have read because it is a bit more personal and human. Unfortunately they chose the one vascular disease about which the most is known both clinically and pathologically as a result of Buerger's fine studies. Because of that the most valuable portions are those dealing with the differentiation of the symptoms of thrombo angitis obliterans and Raynaud's disease erythromelalgia and other vascular diseases and these are scattered.

The treatment of the disease is considered simply and very honestly. Doctors Brown and Allen have had considerable experience in treating this condition with non specific protein and in their hands this has been highly satisfactory. In addition to its therapeutic value the injection of non specific protein has been used to determine which cases might be benefited by operations designed to create an efficient collateral circulation. They point out that one of these surgical procedures lumbar ganglionectomy is indicated in about 1 out of 7 cases. That fact which is accompanied by accurate data should be considered seriously by all surgeons who may be inclined to attack the sympathetic system rather empirically for most of the ailments from which man suffers. It is interesting to note that the authors feel that the results of periarterial sympathectomy are so slight or transient that the operation is not worth while. This conclusion is of course what has been maintained for some time by those who have considered the anatomical facts about the innervation of blood vessels.

MA O CLENT M VOG THIR M AN IT O LIT S
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d Edg V All w th l pt P S l EY by H d R
V H Ph l d lph d Lo d W B S d C mp y o 3

While many conflicting physiological and clinical facts still remain unanswered nevertheless this is a valuable contribution to the treatment of vascular diseases which is welcome. It will help remove that attitude of mind recently expressed by a prominent advocate of perivascular sympathectomy in the treatment of these diseases. It was this. If the patient shows definite improvement after the operation it is Ludwig's disease if he doesn't it is something else.

LOYAL DAVIS

THE second edition of Labat's *Regional Anesthesia* contains valuable additions to the original text. This book has contributed a great deal to the increasing popularity of local methods. While one may not agree completely with the author's selections of the most simple and yet effective procedures there can be no doubt as to the great value of his descriptions based on a large experience both in teaching and practicing local anesthesia.

The chapter on spinal anesthesia has been enlarged. There is perhaps not enough stress laid on the use of ephedrine as a routine preliminary injection. The control of the level of anesthesia as advocated by Litkin is not discussed probably because the book must have been in press when Litkin made his important contribution to the technique of spinal anesthesia. The reviewer feels that the author's conception of the circulatory disturbances during spinal anesthesia is not at all convincing. While there is a vasodilation in the anesthetized field no evidence is given that the blood accumulates in the entire dependent area whether anesthetic or not.

The printing and illustrations are of excellent quality. The book can be heartily recommended to the surgeon who is interested in improving his mortality and morbidity statistics by the routine use of successful methods. There are still too many men who believe only in an occasional use of regional anesthesia for the poor surgical risk and who are painfully surprised when their occasional attempt proves to be a failure. Only a continuous practice can bring the expected results. GEORGE DE LAZARUS

THERE will be some disagreement between some American workers and the English author of *Treatment of Venereal Disease in General Practice*. F. T. Burke who believes that the use of mercury in the treatment of syphilis is as obsolete as is the use of sarsaparilla in medicine. Mercury should be used in the treatment under two conditions (1) that the patient is intolerant to arsenic and bismuth or (2) that these two drugs are unobtainable.

In England stabilarsan (salvarsan) is the drug of choice for intravenous use for intramuscular use sulpharsenol (sulpharsphenamine) is used. After

R O A TH IFS T CILT C VI A IC
G L b t MD W th F w d W l m J M y M D d
T Ph l l lph d Lo d W B S d C mp y o 3
T B k T V DISCA G RA P ACT By F
U ty P DSO MB Ch B (Gl) N w l k d Lo l O f I

cert per l of r enic treatme t i tram u lar
l i m u t h (b i m s t a b) s u s d The uthor deser bes
e of o l e w h i c h c o r r e s p o n d t o i t s u s e s h y
p h i l r a j h e n A m e r i c a

l u t e c h e m e f i t t e a m e n t f o r (1) e a l y p r i
r a p h i (2) p r i m a r y s y p h i (3) e a l y
c n l v a p h i (4) l a t e s e c o n d a r y s y p h i l s (5)
c n l v a p h i (6) t e r t i a r y n l q u a r t e a r y s p h i l s
l (7) u r o p h i e b e l l y o u t l i n e d

C n g n a t l s p h i l m a y b e d e f i n e d a s s y p h i l s
h u l t c u r d i n t e a n d w h i c h m a y o r m a y
t n n i s f i t i t e l f a t b t h S t c t l y s p e a k i n g t h e r e
c h a t t a l e l i t r v s p h i l A l l c n
g e n t l p h i l s h o u l d b e t e a t e d f o r t h e s t a f e
f i l

l i t r t n c t o f a c u t e a n t e r i g n o h o r t h e
a t h t n g l y c o l u m n n u e o f s y g e s b
t h p t n t t e c e u c h p r o c e d u r n o k e p o s t e r
r u r t h r t H e u e u r e t h r a l i g t i o s o f
l t l t e g a n t o t h e p n t f r o m t h e
t t i l o e s l l o c a l t r t m t n t h e o f f c
l h j g e e m m l e l t o r h e a l d i n t e a t
t i l g l v c c i n e a e g i n s a r o u t e
e c i l l a l d t h a t o p l a s a n l a l o o l o i l
l t l a r e l r g a n l h u l d t e e

t u r e l y d i s c a r d e d i n t h e t r e a t m e n t o f g o n o r r h e a N o
r o u t n e t r e a t m e n t i s l a i d d o w n f o r t h e t r e a t m e n t o f
p o s t e r i o r u r e t h r i t i s n o l o c a l t r e a t m e n t a l o n g w i t h
r e c t a l s u p p o r t o r i e s o f a n t i s p a s m o d i c s a r e r e c o m
m e n d e d h e i r r i a t e s t h e b l a d d e r d a i l y w i t h p o t a h
s l u t i o n

I n g o n o r h e a i n t h e f e m a l e h e p e r m i t s t h e p a t i e n t
t o i r r i g a t e h e o w n u r e t h r a a t h o m e V a g i n a l d o u c h e s
a r e g i n a n d t h e i r r i g a n t i s h e l d i n t h e v a g i n a b y
c o t t o n p a c k e d a o u d t h e d o u c h e n o z z l e t o c a u e
h l o o n g

I n t h e a p p e n d x o f t h e b o o k t h e a u t h o r s t a t e s
t h a t i n t r a t h e a l t r e a t m e n t (S w i f t E l l) o f s y p h i l s
i p h y s i o l o g i c a l l y u n o u n d a n d t h e r a p e u t i c a l l y i n
e f f i c i e n t a n d s h o u l d b e a b a n d n e d H e b e l i e v e t h i s
b e c a u s e (1) t h e p a t h o l o g i c a l c h a n g e p r e s e n t i n
e u r o s y p h i l s a r e b u t r a r e l y s u p e r f i c i a l a d a e n o t
t h e r e f o r e r e a c h e d b y i n j e c t i o n s i n t o t h e s u b a r a c h
n o i d s p a c e (2) t h e a m o u n t o f a r s e c p r e s e n t i n
a u t o s a l v a r s a n i z e d s e r u m i s o f n o t r e p o n e m i c i a l
v a l e a n d (3) s a l a r s a n s u b s t i t u t e v h e n g i e n b y t h e
i t r a e n o s r o u t e r e a c h e t h e c e t r a i n e r o u s t e m
t i s a n d t h e c e l o s p i a l f l u i d i n g r e a t e r a m o u n t
t h a n c a n a f e l y b e i n j e c t e d i n t r a t h e a l l y

H A R C t v R

BOOKS RECEIVED

B k I k l d b d t h d p t m e t
d h k l i m t m t h d d t h f l t
t f t l t t l d S i t l l b
d f t l t e t f a d d p
p V d I r f r A y (l a R y l
M t t I W m H p t l I p d b y J N
C k l I M D I R I S (l) M R C P (L d)
C l l l b h W l l m H d b & C m p y
I m t l S A l e r
I J b A l e r P m A m
l C I k C y m A B M D F A C S
N A k D A p p l t d C m f 9 9
C l t r C i A O R 9 9
A l e r f M I S R r
l l l l y H y W C t t h A M M D t h t h
l l l l y H y W C t t h A M M D t h t h
l l l l l l l f i l i J B l p p t t C p v
9 9
U l l r D e t t e l y
A C l l t T C) B y
A t I h t C b l l l t d A H h b
I G t D & C 9
D l I C B A B L
D t B y S H m p R l l t I t K C P I
l h W l l n M N D O I R C P 3 l J I o d n
M m l d C l t d 9
B i r t l r I r M S A T C
R t B k A A U
S I l h A l k p t 6 J t I W h k
t D l t m t f c m B e f t h C

A S R T l y A S f r r M
V A r E d l t y J m T C M D V l
V H I T h A t b a R t e l o l l y C d d
B y A l W l l t G g M D d R l p h d
L d M D N A l l I B H b I 9 9
I n i e t v t t I t A l H e o r r B y
M C P t M D L R C l S (L d) F R C S
(I l) F A C S S t L C V M b y C m p y 10 9
T N P t t c P l y o l o v c
B r l P r c B P L h l A P l d
T l d t y S h d M e M D d J A l b e t
K y M D S t L C V M l y C m p y 19 8
T C t t r c (I h C t l l g) B y C g
M T l l d b y K S S t E d l d t
C v C l b t A B M D F A C S S t I u C V
M b y C m p y 9 9
T r T r N F l A N F l y B y A t h r F
H t l A M M D P h D L l D I A C S 4 t h d
S t I C V M b y C m p y 9 8
B N U r N C B y R B H G d 11
M D d l d F G d h l A B S t L o C V
M l y C m p y 19 8
T l e c t T R E M t o H 10 B y
C h l t o d M l l M D C h i g M o d S g y
P b l t o 9 9
D r H S O G R B y D A k l
T m A r v S t t t g t I d l E k 9 8
C C t I A P M f t t C y o 1
L D A r t e t E J H H l H p
U t r A l A I B H 9 2 8
B r x h l t d I f M r t r y S t
I t H W h t D p t m t f C m
m B u f t h C 9 9

means of gentle pressure on the upper surface thus compressing the organ between the hand above and the light beneath the degree of translucence may be increased. The tail of the breast is best transilluminated by placing the small curved lamp underneath the axillary fold directing the light anteriorly. Both breasts are examined routinely the normal side being transilluminated first to serve as a standard for comparison.

MATERIAL

The material upon which this study is based and the different pathological conditions which have been studied are shown in Table I.

TABLE I—MATERIAL

| | |
|--|----|
| P h i l i d | C |
| ma | 7 |
| B g l d t m s (d f b m) | 8 |
| Bl d g ppl (t a s) t e p p u l o m a d u t e r | |
| om) | 2 |
| M t t | 42 |
| Cyst | 3 |
| l b s | 4 |
| C l a c t e l | 5 |
| H a m t m a | 6 |
| T t l | 4 |

The appearance of the transilluminated breast depends entirely upon its gross anatomical structure. The wide variation in the anatomical constituents of the normal breast is paralleled by corresponding differences in the degree of translucence. Fat is highly translucent whereas fibrous tissue is less so. Thus the fat breast transilluminates unusually well so that even when the breast is very large the light passes through readily. As the fibrous content of the breast increases the degree of translucence is diminished. A breast which is the seat of chronic mastitis or epithelial hyperplasia these so called lumpy breast is still less translucent. Here the opacity is caused by a hyperplasia of the duct and acinous epithelium. The dilated ducts and acini filled with desquamated epithelial cells do not permit the light to pass through readily. Thus it is found that portions of the breast which are thickened are more opaque than other areas in which the hyperplastic or inflammatory process is absent or less marked.

It is important to point out that a certain rare type of breast is unsuitable for trans

illumination. This is the large non pendulous breast closely applied against the chest wall. Lesions located in the depth of this type of breast cannot be approached easily with the light as it is practically impossible to place the lesion between the light and the examiner's eye. Superficial lesions on the other hand can be examined quite satisfactorily by transillumination from side to side.

SOLID AND CYSTIC TUMORS

It has not been possible to detect any differences in the shadows cast by benign and malignant tumors of the breast on transillumination. Solid tumors are opaque to the light the intensity of the shadow varying directly with the size of the mass and to a certain extent with its location in the breast. In this connection it is important to stress one possible source of error. Small solid tumors located near the surface of the breast often give the false impression of being translucent. This is due to the diffusion of light around the tumor caused by the intense light closely applied to the small mass. The proximity of the lamp to the mass is the main factor. On closer examination a faint shadow can usually be made out. Under these conditions it is important to interpret the faintest shadow as positive for a solid mass. A similar optical illusion is reproduced when the light is applied directly against the palmar surface of the phalanges. The bones of the fingers appear to be translucent for the same reasons which have been pointed out. This error may be avoided by the reduction of the intensity of the light by means of the rheostat and the placing of the lamp away from the tumor.

Cysts containing clear fluid have proved to be translucent a finding which may be of considerable importance in differential diagnosis. Whereas in many instances the clinical findings are sufficiently positive to permit a differentiation between solid and cystic tumors of the breast certain cases offer the greatest difficulty in this respect. Especially is this true in tense deep seated cysts which because of a secondary inflammatory process exhibit skin adherence. Under these circumstances a simple cyst may give the impression of a firm solid tumor and in the presence of skin

adherence may lead to the diagnosis of carcinoma. That this error may occur even in the hands of those with considerable clinical experience is shown by the following cases.

CASE 1. Female aged 38 years stated that she had noted a tumor in the tail of the left breast for 6 months. The swelling had increased in size slowly and had been associated with some pain. Upon examination there was found a firm deep seated tumor about 3 centimeters in diameter located in the upper outer quadrant of the left breast. There was slight elevation of the nipple, a suggestion of skin adherence and several enlarged nodes in the left axilla. A clinical diagnosis of carcinoma of the breast was made by three examiners independently. Transillumination of the breast failed to show any opacity in the region of the tumor, the mass being completely translucent. On the basis of the transillumination findings a needle was inserted into the mass and yielded 20 cubic centimeters of clear straw colored fluid, thus causing a collapse of the tumor.

CASE 2. A gross specimen consisting of left breast pectoral muscles and axillary contents was sent to the pathological laboratory with the clinical diagnosis of carcinoma of the breast (this breast had not been transilluminated before operation). Inspection of the gross specimen revealed a firm, somewhat movable mass in the central portion of the breast. The specimen was transilluminated and the mass found to be completely translucent. On the basis of these findings a diagnosis of cyst was made and an incision into the mass confirmed the diagnosis. The tumor was a benign cyst 3 by 4 by 4 centimeters filled with clear straw colored fluid.

It is quite evident therefore that transillumination may be the only pre-operative means of establishing a diagnosis between cyst and solid tumor in a certain small but definite group of cases.

HEMATOMA

The opacity of blood to transillumination is demonstrated in cases of hematoma resulting from injury to the breast. The transillumination findings in these cases may be of considerable help in the interpretation of the nature of the lesion and are often an important guide in treatment. The frequency with which a history of trauma preceding cancer of the breast is elicited is well known. In many instances further questioning fails to establish the presence of any definite relationship between the trauma and the tumor. On the other hand, an occasional direct association between trauma and the appearance of a

tumor cannot be escaped. In a certain group of cases a direct injury to the breast sufficient to cause discoloration of the skin is accompanied by a distinctly localized tumor. In some cases there is definite dimpling of the skin. A differential diagnosis in this group between traumatic hematoma and early carcinoma is extremely difficult yet most important from a therapeutic standpoint. In the following cases the transillumination findings were of considerable aid in the differential diagnosis.

CASE 1. Female aged 44 years. On December 18, 1917, the patient fell and struck her right breast against the sharp edge of a scrubbing pail. Within 4 hours she noted black and blue discoloration of the skin over the inner half of the right breast accompanied by severe pain and moderate local tenderness. One week after the injury she developed a lump in the upper and inner portion of the right breast. Upon examination there was found a mass 1.5 by 1.5 by 1.5 centimeters in the upper inner quadrant of the right breast close to the skin and adherent to it. There was definite dimpling of the skin. Transillumination of the breast showed an intense opacity 5 centimeters in diameter with irregular fuzzy edges extending into the surrounding breast tissue. The interpretation of the findings was that we were confronted with a traumatic lesion and not a carcinoma. The lesion gradually disappeared without treatment. With the disappearance of the tumor this area became more translucent. At the end of 3 months the opacity had completely disappeared and there was no clinical evidence of disease.

CASE 2. Female aged 44 years. Two weeks before admission to the hospital the patient fell and struck the right breast against an iron bed post. This was followed by localized pain, tenderness and discoloration of the breast at the site of injury. Examination showed a firm mass 2 by 2.5 centimeters in the upper outer quadrant of the right breast with definite skin dimpling over it. Transillumination showed a dense opacity in the region of the tumor varying in intensity with an irregular periphery extending into the surrounding breast. One week later the skin dimpling had disappeared, the tumor was softer and smaller and the opacity was markedly reduced in extent and intensity. Three months later the tumor had completely disappeared and there was no opacity on transillumination.

The transillumination findings in these cases are characteristic in several respects. The opacity is intense, being only such as is produced by blood pigment. It varies in intensity in different parts corresponding to variations in the amount of unabsorbed blood in different portions of the hematoma. The edges are

irregular in outline and extend into the surrounding breast tissue beyond the palpable edges of the tumor. This irregularity is due to the extravasation of blood into the surrounding tissues. Finally the opacity gradually diminishes in intensity and extent and ultimately disappears completely. These findings may be correlated readily with what is known to occur in the formation and absorption of a hæmatoma. Keeping in mind that the opacity is due to the blood pigments. The opacity found in these cases is unlike that seen in any other condition. It differs from that caused by an intracystic papilloma in that the latter produces a circumscribed uniform shadow with sharply defined edges. It differs from the opacity of a solid tumor such as carcinoma in its intensity which is never approached by any lesion in which blood pigments do not participate.

ACUTE MASTITIS

Five patients were observed with acute unilateral mastitis associated with lactation. The onset was acute with sudden development of pain, œdema, redness, chills and fever. Examination showed diffuse swelling of one breast with all the signs of acute inflammation, exquisite tenderness and axillary adenopathy. The acute inflammatory process gradually subsided over a period of several weeks leaving a localized tumor which required several months to disappear completely. Transillumination of the breast in these cases showed a diffuse opacity of the affected breast which gradually diminished as the inflammatory process subsided. In all these cases the complete translucence of the breast was not re-established until 3 months after the acute process had begun to subside. The transillumination findings in this group of cases differ from those found in carcinoma in that the opacity at first involves the entire breast and gradually diminishes in extent and intensity, whereas in carcinoma the opacity is localized and either remains stationary or gradually increases.

LACTATION GALACTOCELE

The lactating breast is found to be completely opaque to transillumination. The opacity of milk is further demonstrated by the ap-

pearance of a galactocoele on transillumination which also fails to transmit light and is seen as a sharply circumscribed opaque area corresponding to the location of the tumor. Since the differential diagnosis of galactocoele from other lesions is usually not difficult clinically, the practical application of this finding is of limited value. In certain cases however in which the clinical diagnosis is otherwise in doubt, transillumination is of great aid in the interpretation of the nature of the lesion.

TRANSILLUMINATION OF BLEEDING NIPPLE

It is not within the scope of this paper to enter into a full discussion of the subject of bleeding nipple. It is desirable however to consider briefly the present conception of the pathological anatomy underlying this syndrome in order to correlate these changes with the transillumination findings. A review of the literature indicates that the significance of a hæmorrhagic discharge from the nipple is still a matter of dispute among clinicians and pathologists. Many investigators favor the view that a hæmorrhagic discharge from the nipple of a non lactating breast is evidence of a benign rather than of a malignant lesion and is almost a positive sign of intracanalicular papilloma (Bloodgood, Greenough and Simmons, Deaver and McFarland, Sistrunk). Miller and Lewis on the other hand found the same proportion of benign and malignant tumors associated with this disease and Judd in a review of 100 cases reached a similar conclusion. The most detailed and comprehensive descriptions of these lesions is furnished by Cheatele. As a result of careful studies of whole sections of the breast he finds two types of papilloma as follows. The uniradicular usually multiple occurring in the deeper portions of the breast and rarely malignant and the multiradicular usually occurring singly and near the ampulla of the ducts and more likely to undergo malignant degeneration. In a recent study Knoflach and Urban found the common lesion to be circumscribed mostly single occasionally multiple papillary growths in ducts or acini showing the histological features of a benign process.

An interesting and important group of cases is that in which a hæmorrhagic discharge

from the nipple exists with no palpable tumor in the breast. The underlying lesion in these cases usually consists of one or several minute papillomata located for the most part in the depth of the breast which because of their size and location cannot be felt on palpation. Sometimes a slight localized thickening furnishes a clue to the location of the lesion and pressure over this area causes an escape of blood from the nipple but there remain certain cases in which palpation of the breast fails to reveal any evidence of tumor or thickening and accurate localization of the source of bleeding is impossible. Bloodgood refers to 2 cases in which the breast was removed and small papillomatous cysts containing blood were found when the breasts were sectioned. In 5 other cases with a discharge and no palpable tumor no operation was performed the hemorrhagic discharge disappeared and the patients remained well. Miller and Lewis recognize this group of cases. They state that when a serohemorrhagic discharge occurs and no tumor is palpable the lesion is in all probability a small benign intracanalicular papilloma situated deep in the substance of the breast and that it should be removed. Knoflach and Urban discuss this group of cases and point out the difficulties in localization of the lesion and in treatment. They state that in many cases it is not possible to locate a point at which pressure causes bleeding from the nipple even after repeated examinations.

It is quite obvious therefore that any procedure which would enable a more accurate localization of the lesion and a better conception of the distribution of the disease throughout the breast would be of considerable practical aid in the treatment of these cases. As has already been pointed out the marked opacity of blood is one of the most striking features of the translumination of tissues. The intense opacity of hematoma of the breast has already been referred to. From these observations it was logical to suspect that the underlying lesion in cases of bleeding nipple being essentially a bleeding process might yield to localization by translumination a suspicion which was readily confirmed when the first case was examined by this

method. It soon became evident that this simple procedure was an invaluable aid in determining the localization and extent of the lesion and the distribution of the process.

The appearance of the transluminated breast associated with bleeding from the nipple depends upon the gross anatomy of the disease. Thus a single localized papilloma in a duct or acinus presents an opacity of corresponding shape and size an opacity which is characterized by two specific features namely its intensity and its sharply outlined periphery. In its marked opacity it differs from shadows cast by any other lesion not associated with blood pigment. In its sharply circumscribed outline it differs from the irregular fuzzy appearance seen in hematoma or the faint indistinct periphery of solid non circumscribed tumors. In several cases not only the papilloma itself has been localized but the duct leading to the nipple filled with blood clot could be followed throughout its course.

Cases in which the breast is the seat of multiple papillomata present a striking appearance. In some cases as many as six discrete opacities were seen each probably corresponding to a minute papilloma in a duct. In these cases no tumor could be felt on palpation and attempts to localize the lesion by pressure were futile because of the diffuseness of the process. That the opacity is due mainly to the blood and not to the papilloma is suggested by the fact that when the dilated duct or cyst is emptied by constant pressure the opacity diminishes markedly and often completely disappears and that when the duct is refilled by gentle massage of the breast the opacity promptly reappears. An incidental finding of interest is the discovery in several cases of similar opacities in the opposite breast from which no bleeding had been detected. Since no pathological proof is available the cause of these opacities cannot be stated with certainty although it is logical to assume that this finding indicates a similar process in the apparently normal breast in which bleeding from the nipple does not occur because of the failure of such lesion to communicate freely with a terminal duct the bleeding perhaps being less active and therefore slowly absorbed.

TABLE II

| C | A | D
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|---|------|-----------------------|--|-------------------------------------|-------------------|--|---|---|
| 4 | | m | Bloo | \ g | | Loc f | D l d d b l l d
h l l h b
a l m m l l p p | \ f t b d
P t r m t l a |
| 5 | y | | Bloo | C by mas
b m t l f | | Lo i | C y s by f d b
b l l m t t g h
p h l l m t t g h
d t w l l by
p d l | N s pac y f t
h t b d u s
P h s p m t s o
h w s d p e
f t y |
| 3 | | m | Blood | \ g | | L i | D l d d m m
t a s g min
p p u l m | N d i s e a s |
| | | m | Blood | N | | Loc f | C d d d l d
m l l m l l m h
blood | N f h d
h g |
| | | m | | T m s by
by s m b e
l p l f f | | K d
m t m y | C f l l d n
m t l | \ d s e |
| | k | Bloody | S l g h l o c l d
t h k l l o n p
d d h t h p
p l | | | Lo i | S m l l b d m y
m m d m y | B l d t m p d
p l l o c l
t t l l
m l p l p e d
P d N l d m g |
| 7 | | m | Bloody | \ g | | Lo i | D t m | N v d t
d a s |
| 8 | 8 | m | S g | \ g | | N | | T m r l y l o s
t k f |
| 9 | | m | S b in | D l a h k
g b b h
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m
(m d)
l | N p e t | N f h d
h a r g |
| | s yr | Blood | M a s d m m
l f b t | | | O l h g
l g b
m b y
(t h m dos) | | B l o o d y d h a r |
| | | m | Blood | M a s s by s
m p d f l f | | T l l y
m t a | N p e | B l o o d y d o c h
p p d f o r 6
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| 5 | | m | Blood | \ | | | | T m p o e d y k n
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MULTIPLE PAPILLOMATA

Whereas in most cases a hemorrhagic discharge from the nipple is caused by a single localized and circumscribed lesion the underlying cause in some cases consists of a diffuse pathological process consisting of numerous minute papillomata in dilated ducts. Although the association of this process with certain cases of bleeding nipple has been previously recognized a clinical differentiation of these cases from those in which a single lesion is the causative factor has not heretofore been possible. This group of cases presents an important therapeutic problem. Thus Knoslach and Urban advise a complete mastectomy in these cases as against a local excision in the other group. Their procedure consists in local excision of the suspected area and if the microscopic examination of the excised specimen indicates a diffuse process a second operation is performed and the entire breast is removed. This double procedure is necessitated by the inability to differentiate clinically between cases of single and multiple lesions. These authors report 3 cases in which local excision alone failed to stop the bleeding from the nipple one case requiring a second operation. They warn against a too narrow excision because of the danger of leaving pathological tissue in the breast. Transillumination of the breast in these cases presents a striking picture consisting of multiple small opacities throughout the affected breast and sometimes also in the opposite breast. The opacities are intense discrete and localized. The following case is of special interest in this connection.

CASE 1. L. G. Aged 45 years was admitted to the hospital May 19 1926. Two weeks before admission she had noted a small amount of bleeding from the right nipple. Upon examination no tumor or thickening could be made out in either breast. Point pressure over an area in the upper inner quadrant of the right breast caused an escape of blood through the nipple. In May 19 6 2 X-ray treatments were given over the right breast. Two similar treatments were given in December 1926 and one in July 1927. Following each treatment the bloody discharge stopped for varying periods at one time for as long as 6 months. In January 1927 a localized thickening was first noted about 4 centimeters above the right nipple and in December 1927 a local excision of this segment was performed. Examination of the specimen showed it to be composed of a small butter cyst 1.5 centimeters in diam-

eter directly connected with a dilated duct and filled with a thick pasty material. The walls of the duct and cyst were smooth and no papilloma could be found. Bleeding from the right nipple continued after the operation. In March 19 8 two high voltage X-ray treatments were given over the breast and there has been no bleeding since. Transillumination of the breasts in this case was first carried out on July 15 1928 8 months after operation. The right breast showed a healed incision with no opacity at the operative site. In the areas indicated on the diagram there were two small sharply circumscribed opacities presenting the characteristic appearance found in these cases. Upon transillumination of the left breast multiple opacities of a similar nature were found closely grouped in the region of the areola. (See Table II Case 6.)

Thus it is seen that in this case we encounter a pathological process which is widespread and present in both breasts and which cannot be differentiated clinically from those cases of bleeding nipple in which the underlying cause is a single papilloma in one breast. The inability to localize the disease and determine its extent is embarrassing from a therapeutic standpoint as is well illustrated by the failure of the local excision to eradicate the disease. It is also quite evident that a narrow local excision in these cases is useless. The wide extent of the process calls for a radical surgical procedure if the whole disease is to be eradicated. The ultimate fate in those cases in which opacities are found in the non bleeding breast is not known. A point of special interest is whether such a breast will eventually develop bleeding from the nipple.

Table II shows the findings in 12 cases of bleeding nipple examined by transillumination. Localization was possible in all cases in which the discharge was distinctly bloody except in 2 instances. In several cases a re-examination was necessary and the lesion finally localized when a discharge which was at first serous in character became more sanguinous. In several cases localization was not possible because following repeated examinations by palpation the cyst or duct had emptied itself. In these cases subsequent transillumination before palpation of the breast readily demonstrated the characteristic opacity. In 4 cases a single localized tumor or thickening in the breast could be detected by palpation. Of 9 cases in which the palpation

findings were negative localization by transillumination was possible in 7 instances. Nine cases presented one opacity indicating a single localized lesion whereas in 3 cases 2 or more opacities were demonstrated in the affected breast indicating multiple lesions. In 2 cases opacities were noted in the opposite breast from which no bleeding had been detected. The transillumination findings were confirmed at operation in 7 cases. In those cases in which no tumor could be palpated the transillumination findings were utilized by the surgeon as a pre-operative measure and the localization reported to have been an accurate guide in the operative procedure. Three cases in which the lesion had been removed were subsequently examined with the light and in all instances the opacity had completely disappeared. In 1 case operative removal of the lesion as determined by palpation failed to stop the bloody discharge. Subsequent transillumination in this case demonstrated multiple opacities in both breasts thus indicating that the operative procedure had removed only a portion of the diseased tissue. Three patients have been treated by external radiation. The bleeding has stopped in 2 cases. In 3 cases the lesion was located by transillumination but the subsequent course is at present unknown. In one case of bleeding nipple in which no opacity could be demonstrated the excised specimen showed early duct carcinoma and no evidence of papilloma. This finding corroborated the negative transillumination findings.

It is important to emphasize that when the discharge from the nipple is not distinctly hemorrhagic localization by transillumination is often impossible.

SUMMARY AND CONCLUSIONS

1. A study of 174 cases of pathological conditions of the breast has demonstrated that transillumination is a valuable aid in differential diagnosis and treatment.

2. The transillumination findings vary in the different types of normal breast depending chiefly upon the relative content of fat, fibrous tissue, and epithelial elements.

3. Acute, subacute, and chronic inflammatory processes present a diffuse opacity in the

affected area which diminishes and disappears as the inflammation subsides.

4. Solid tumors are opaque, the degree of opacity depending upon the size and location of the mass. The character of the opacity, however, does not permit a differentiation between benign and malignant tumors.

5. Cysts filled with clear fluid are translucent, a finding which may be of considerable value in a differential diagnosis between carcinoma and tense deep lying cysts which display skin adherence and present the clinical features of a malignant tumor.

6. The intense opacity of blood is one of the most characteristic and important findings in the transillumination of tissue.

7. Traumatic hematoma presents a characteristic appearance on transillumination. The opacity is intense, uneven, irregular in outline, and disappears as the blood is absorbed. This finding may be utilized in the differential diagnosis from carcinoma in those cases of hematoma in which skin adherence is a prominent feature.

8. Intracystic or duct papilloma associated with a hemorrhagic discharge from the nipple presents a characteristic and specific appearance on transillumination. The opacity is intense, uniform, and sharply circumscribed.

9. Transillumination is of special value in those cases of bleeding nipple in which no tumor can be palpated. In these cases in which localization of the lesion has heretofore been difficult or impossible, transillumination usually enables localization of the lesion and thereby directly indicates the site for operative removal.

10. Transillumination furnishes a method of differentiating between cases of bleeding nipple due to a single localized papilloma and cases in which multiple papillomata constitute the underlying cause. This finding is of considerable practical importance in offering the only pre-operative method of interpreting the nature of the process and indicating the extent of the disease.

11. The practical importance of differentiating between single and multiple papillomata is demonstrated by those cases in which the removal of a duct papilloma has failed to cure the disease but which on subsequent trans-



Fig 1



Fig 2

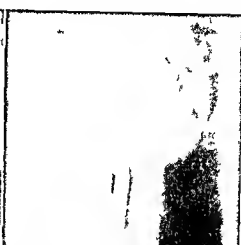
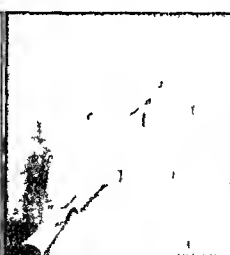


Fig 3



Fig 4



F



Fig 6

Fig 1 The normal breast when transilluminated demonstrates the position of the light during the examination

Fig 2 A diffuse opacity found on transillumination of a breast which is the seat of chronic mastitis

Fig 3 The appearance of a solid tumor in the breast when transilluminated. The character of the opacity is the same in benign and malignant tumors

Fig 4 The appearance of a traumatic hematoma of the

breast when transilluminated. The opacity is intense and even and regular in outline

Fig 5 The appearance of an intracystic papilloma and dilated duct filled with blood in a case of bleeding nipple as seen on transillumination

Fig 6 The appearance of multiple papillomata as seen on transillumination. The straight line represents the site of local removal of one lesion which failed to stop the bloody discharge. Opposite breast showed five opacities

illumination have shown several opacities indicating multiple lesions

Transillumination is a simple safe and valuable aid in the interpretation of pathological conditions in the breast and is recommended as a useful diagnostic procedure in the routine examination of this organ

The author is highly indebted to Drs W S Stone and Lloyd Cray for their interest and many helpful suggestions and to Drs B J Lee and Frank Adair of the breast division for their cooperation and courtesy of placing their material at the disposal of the author

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A CLINICAL STUDY OF EIGHT CASES OF MYOMA MALIGNUM

BERNARD F. SCHIRFNER, M.D., F.A.C.S., BUFFALO, N.Y.
 I f h s by M.L.G. D. B. F. M.T.D.

AMONG 103 cases of tumors of the uterus which have been examined and treated at the State Institute during a period of 14 years 1914 to 1929 845 were epithelioma of the cervix 41 were adenocarcinoma of the cervical canal 11 were adenocarcinoma of the fundus of the uterus 1 was epithelioma of the fundus of the uterus (metaplasia) 197 were leiomyoma (fibroids) and 8 were malignant leiomyoma.

The percentage of malignant leiomyoma of all tumors of the uterus in this series is six tenths of one per cent. Various authors (Lwing and others) give the percentage of malignant leiomyoma as it occurs among fibroids as being 1 to 10 per cent. Ours showed a little less than 4 per cent. all of which were recurrences after operation.

Rather than attempt a resume of the histopathology in this disease I would urge all to read Ewing's short article on Myoma Malignum which begins: "In a group of cases now rather numerous leiomyoma has proved malignant breaking its natural boundaries and producing metastases in liver lungs kidney peritoneum and lymph nodes thereby requiring the designation *myoma malignum*." In this article he states clearly and concisely his own interpretation as well as that of Evans Cullen Winter and many others who systematically examined numerous portions of fibroids of the uterus. Macroscopically and histologically they describe pictures of these growths varying all the way from very cellular areas which showed the evidence of active proliferation up to the most profound pictures of true malignancy being careful to point out that some of these histological pictures described may be still within the realm of benign tumors or may be unquestionably malignant. In addition to these references a paper by Proper and Simpson in 1919 should not be overlooked.

The age incidence at the time of admission was one each 24 31 48 50 52 61 and 63 years.

Six of these women were married 2 were unmarried. In only one instance was there a hereditary history of cancer. The blood Wassermann reaction was negative in each of these cases. There was a history of from 1 to 6 pregnancies in 6 cases 2 had had a miscarriage. Previous treatments in these 8 cases consisted of panhysterectomy in 3 instances and supravaginal amputation in 5 instances which were performed from 1 month to 9 years prior to their admission to the Institute. One case had had radium treatment.

As there are so few case a short resume of the case histories seems worth while.

CASE 54: Married 25 6 pre-natal no menstrual disturbance until a severe bleeding occurred after her last pregnancy in July 1918. She had a panhysterectomy performed in the following November and sections of the uterus were diagnosed as spindle cell sarcoma. In January 1919 she was admitted to the Institute with a recurrence in the vault of the vagina and broad ligament areas which was treated with radium tube against the lesion. A radium applied over the pelvis bleeding as controlled but the tumor progressed rapidly metastasizing causing death 8 months after admission. To morrow should occur ces in the pelvis causing hydronephrosis metastasis of the mesentery to the lymph node in the ribs (Fig. 1).

CASE 6698: Married age 48 years had three normal pregnancies. Menstrual history normal until the age of 43 when she complained of pain in the pelvis. Examination showed tumor of the uterus for which she had supravaginal amputation in May 1917. Histological examination showed leiomyoma. In December 1919 she had a tumor removed from the broad ligament area section of which showed malignant leiomyoma. She was referred here for postoperative radiation and at the time of our examination in March 1921 the cervix which remained showed laceration there was recurrent tumor mass in the region of the left broad ligament area. She treated with radium packs applied over the pelvis which ultimately appeared in the tumor in the left pelvis in 6 weeks. She gained 37 pounds in the succeeding 15 months with a complete absence of recurrence as apparent for 3 years when the tumor occurred metastasis in the liver causing death 3 years 8 months from the time of a recurrence.

CASE 471: Single aged 5 years. Menstrual history no malmenstruation at the age of 44. In the



Fig 1 CASE 5422 Photomicrograph of one of the metastatic nodules removed at autopsy

summer of 1920 at the age of 50 she began to have pain in the pelvis and there was a tumor mass in the uterus which grew rapidly. A supravaginal amputation was performed in August 1920 for supposed fibroid. Section of the tumor showed malignant leiomyoma. One year later she began to have symptoms of partial obstruction of the bowel and when she came here in March 1922 examination showed a tumor mass filling the pelvis causing pressure on the rectum and partial obstruction of the bowel. She was treated with radium packs and high voltage X-ray from March 1922 to January 1923 at which time regression of the tumor with general improvement in health was noted. In February 1923 a tumor mass in the upper abdomen appeared and caused edema and swelling of the legs and genital. She grew progressively worse and died 1 year and 11 months from the time of admittance.

CASE 8398 Married age 24 years 1 miscarriage at 3 months. Menstrual history normal except for profuse flowing. In February 1924 the menstrual periods were excessive and a tumor of the uterus was diagnosed. Supravaginal amputation was performed and sections of the fibroid showed malignant leiomyoma. In March 1924 1 month after operation she was admitted to the Institute and treated with

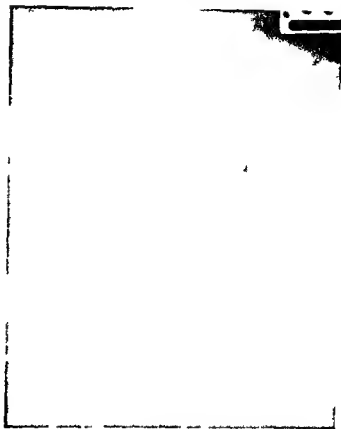
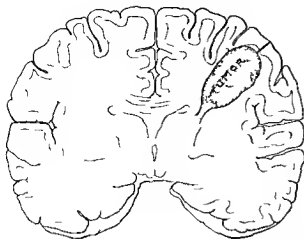


Fig 2 CASE 8398 X-ray photograph of the lungs showing metastatic nodules from the tumor November 1928

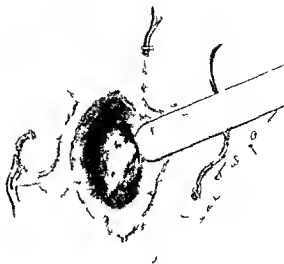
high voltage X-ray through the pelvis. She has been free from recurrence for 4 years and 9 months.

CASE 1 Single age 50 years. Menstrual history showed irregularities all her life. In 1916 when 4 she began to have severe abdominal pain and discharge from the vagina profuse flowing at the periods and in 1917 and 1918 she had growths removed from the uterus with temporary relief. She had a panhysterectomy performed in 1919. There was no histological report obtainable at this time. Bleeding recurred and in 1920 she had radium treatment with improvement for 1 year recurrence of bleeding and radium treatment again in 1921 and again in 1922. She was then free from trouble until December 1923 at which time bleeding recurred and she began to lose weight. She was referred to me in April 1924 for treatment. The entire pelvis was filled with an infiltrating tumor mass and there was ulceration in the vaginal wall. Section of tissue removed at this time showed malignant leiomyoma. She was treated with radium applied internally and high voltage X-rays. She was unimproved and died from metastases 1 year and 9 months from the time of admission.

CASE 9513 Married age 31 years 1 child is living she had 1 miscarriage at 7 months. Menstrual history was normal up to 30 at which time she had a severe hemorrhage March 1925. In June 1925 she was operated upon for a fibroid supravaginal amputation was performed and section of the tumor was



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of symptoms so that unless influenced by surgical therapy the disease may run its course to a fatal termination within or 3 months. Intense headache, mental dilapidation, marked signs of increased intracranial pressure are almost the rule and rigidity of the neck, unequal pupils and various degrees of motor and sensory disorganization are frequent. The symptoms are due not alone to the tumor itself but to the very marked oedema and swelling of the lobe in which it is situated. The spongioblastomata formed 30 per cent of Cushing's and 41 per cent of our verified clinical cases.¹

The *medulloblastoma* is not as malignant in its course as the spongioblastoma and the progress of symptoms may for a considerable period be a slow one. This variety of glioma occurs most often in children especially in the superior vermis on the roof and caudal extremity of the fourth ventricle. Clinically this growth appears more malignant on account of the early occurrence of obstruction in the cerebrospinal fluid pathways and because after the tumor has reached a certain size it appears to change its character from that of a fairly well encapsulated growth to one which invades more and more of the cerebellar tissues and the meninges. On account of their location these midline tumors may for a considerable period cause few cerebellar disturbances and marked symptoms referable

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k t h (l b t d f m u g p at

to one or other cerebellar lobe may occur only when there is a secondary cyst or after the growth has burst through its capsule and has invaded one hemisphere. The medulloblastomata occurred in 11 per cent of Cushing's series and in 10 per cent of our cases of verified infiltrating tumors of the brain.

The more differentiated gliogenous growths especially the highly differentiated fibrillary and protoplasmic *astrocytomata* increase in size more slowly than either the spongioblastomata or the medulloblastomata. The clinical course is correspondingly slow and they are very prone to undergo calcification or cystic changes. Many of the symptoms caused by these growths are due entirely to pressure and it is rare to find at operation the marked brain hyperplasia and oedema that is almost a regular feature in the spongioblastomata. The astrocytomata are the most

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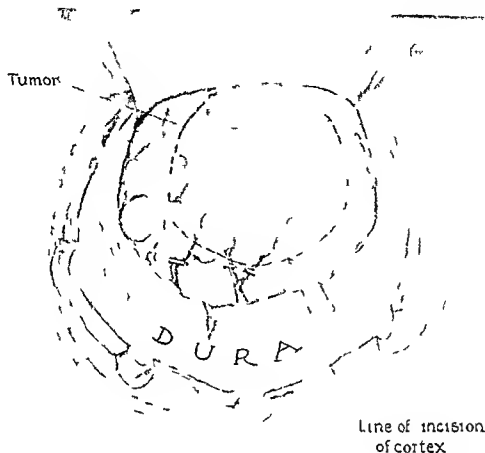


Fig. 3. Case 2. Showing the recurrent tumor prior to the second operation (liberated from surgeon's operative sketch).

favorable of the infiltrating growths for radical surgical extirpation. In many instances the tumor itself is of relatively small size although the cyst may have considerable dimensions. In Cushing's series 36 per cent and in ours 20 per cent of the gliomata belong to the astrocytoma group.

The first experience of the writer with this type of case recognized as such was the following:

CASE 1. MSH 252520, a professional song writer 33 years of age began to suffer in 1900 from convulsive seizures which affected the limbs of the left side. Under luminal treatment the attacks became less frequent until 1924 when they recurred and were followed by increasing weakness of the left upper extremity. In March of 1925 he was admitted into the hospital in osteoplastic flap turned down under novocain and a large infiltrating tumor exposed in the posterior part of the right frontal lobe. As the patient stood the operation badly, a specimen was removed for verification and the bone flap was returned into place with a liberal bone and dura defect for decompressive purposes. There was

at first some improvement but after a few weeks the convulsion recurred and became more and more frequent until finally he was in a status epilepticus with an almost complete loss of power in the left upper and lower extremities.

May 13 1925. Again under novocain anesthesia the bone flap was turned down and a mass of tumor tissue about the size of a golf ball was removed in fragments. This second operation was better borne and after it he recovered so much power that he could be discharged on June 6 free of symptoms and practically well. He was well and at work for about one year before he had another convulsive seizure and in the ensuing 12 months he had an occasional attack with a slowly progressive weakness of the affected limbs. He was readmitted in April 1927 with a spastic hemiplegia and sensory symptoms on the left side of the body.

May 14 1927. A third operation was done under novocain. The flap was again turned down and a tumor mass about 3 by 2 centimeters in size was found and excised from the area of the previous operation. When he left the hospital after an uneventful postoperative course there had been some improvement in the power of the paretic limbs and he had not had any convulsive seizures. Two months later he was able to get about with the help of a

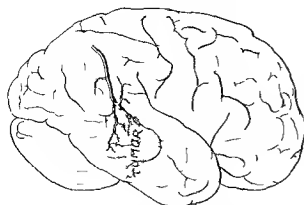


Fig 4A C 3 Sh th l t f th t m



Fig 4P C 3 Sh the lo to f th tum

came although the e had been l ttle improvement n the po er of the l ft hand. He as able t be about until the e d of 925. The la t note (Ja u r v 10 19 0) states: "Ca n t alk a d s nc nt nent. Ve y marked pyram dal ig on left s de. Tr mo of right upper ext em tv f ba al gan lon type ls steadily losing ound nd ery eak. Has been recei ng ad i therapy. It o o vea s f om the beg nni g of the pat ent s s mptoms nd almo t 4 vea s f om the time of th fir t j er ti

This patient was operated upon before I had any knowledge of or experience with electro surgical methods and the tumor removal was reco gnized to have been incomplete. There fore in spite of the fact that l ttle beneft was to be expected the patient was given radio therapy. Had the value of the electro urgical knife been known to me at the time this would have been a very promising case for radical extirpation. The lesson of this experience was not lost however and it led to a more radical procedure in a second patient

CASE. MSH 276995 a t lo 39 years f ge va admitted to the Neurological Service n February 22 19 7. He gave a history that 6 month befo e he had had a sudden attack of unco scious ne s foll w d by con ul ve seizure always preceded by an au a of an elect ic se at n in the nge of the left hand. For se e al m nth befo e h s adm s o to the hos pital he suffered f om he d ache a d there a a slo ly p gre el s of po er n the left arm and le. He was fo nd to have some m ntal changes lo gr le f pap iladem a left ent al faci l eakness a left hemiparesis with spastic tv and i crease of tendon esse e and diminution f both cutan us and deep se s b l ties o th left side of the body.

It was cl a that the patient had ne gro th in the ht parietal lobe a d n Februa v 7 th t area v e pos d by a l rg ost oplastic f p m de u de loc l aesthesia. Th con oluti ns of the parietal lob appea ed f t t ned and ith punc tu e needle 25 cubic c ntimeters of vanth chrom fluid was withdra n f m a cv t r b ut centimeter b neath the su fac. A nc sio va mad through the cort x (Fig and 2) nd at a depth of 2 centimeters a bo n h tum a po ed which d d not hav any v ll d fied ma g n. An i c v s m de all ar and th tun r i hat ppea e l to be normal b an ti e and gradually leepene l. Fi e ce ntimeters bene th the co tex h t appea e l to be a no v ped cle s e posed. Th p d cle wa divided and its base ca teri el ith Ze ke solution. Bleedi g as c ntrolled by means f irri ton and p essu e ith c tton b t one la g tery in the depth had to b l g at d. The size f the gr th as 5 by 3 centimeters.

Recovery from the operat on e entful l t e ere headache and pap illed ma per i t d. O April 5 n the su p cio that the exci h d n t bee ompl te or that ham hag h d o rre l t the c vity left ster th tumo em I th o teopl tic f p as gai le ated.

Th cavity f om hich the tumo h d b e re mo ed va f and d i te ded vith f d but n e vi dence of tumo t sue could be disco ered. The

Fig 5 C 3 Sh rin th pp f th p t t
three k ft op r t n

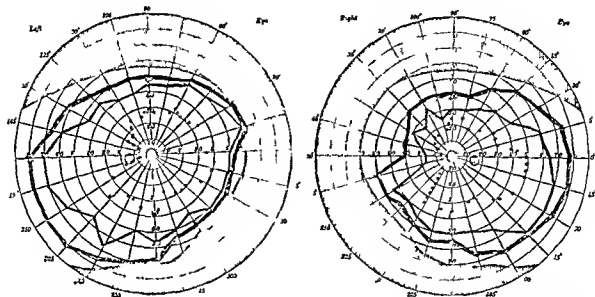


FIG. 6 Case 3 Showing the improvement in the visual field. The bold lines show the fields before operation the light lines the fields 7 weeks after operation

fluid was evacuated and the wound again closed. The headache soon disappeared and excepting for persisting spasticity and weakness of the left upper and lower limbs he remained well up to January 1929.

Added note January 27 1929. He was readmitted with a history that he had suddenly become stuporous 4 hours before. The old bone flap was again elevated and a recurrent tumor 5 by 5 centimeters in size was extirpated with the electric knife the incisions in the brain being made in apparently normal brain tissue (Fig. 3). About 60 cubic centimeters of yellow fluid was evacuated from a cyst cavity and the cyst wall excised with the electrified loop.

The patient has recovered satisfactorily from the operation and there is some improvement in the power of the left upper extremity.

Pathological report showed the following: Fragments of highly cellular gliogenous tumor. It is very vascular and contains a few islands of spongioblastic tissue. There is also present at the periphery of the tumor an increase in connective tissue giving the impression of encapsulating it. The connective tissue has in its lacunae many macrophages.

Troublesome bleeding during the course of the tumor removal at the operation done in February 1927 and above described led me to the determination to try the electrosurgical apparatus which had been used for some years by Dr. Beer and his colleagues for the removal of bladder tumors. As chance would have it the next patient who came to operation was a woman with a meningioma on the under surface of the frontal and temporal

lobes derived from the basilar dura near the cavernous sinus. The growth which could be adequately exposed only by an incision through the brain tissue was removed by piecemeal excision with the high frequency current and electric knife. It needed only this one experience to convince me of the great value of the electrocautery knife both for the control of bleeding and for the actual tumor removal. Since that time the endotherm as the apparatus which we then had on hand was called has been ready for use at every operation for brain tumor.

The value of electrosurgery for the removal of meningeal tumors is however a separate matter which has been considered with the usual thoroughness and brilliancy of the author in the article published in this journal by Dr. Cushing.¹

Until recently I did not have an apparatus which could be used with complete satisfaction for the control of bleeding from single vessels which would deliver a dehydrating or desiccating current for the control of general oozing or with which division of vascular brain or tumor tissue could be accomplished with as little or as much cauterizing effect in addition as was desired. The apparatus of Dr. Bovie which we are now using is the

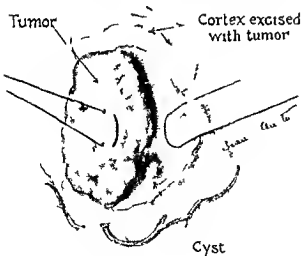
C. B. G. H. I. N. W. I. E. I. t. g. y. d. t. h.
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784



I C 4 Sh g th pp ft th il p gh db b g f th t mo

most perfect one that has up to the present time been devised

By means of the Bovie machine bleeding from small vessels can be speedily and satis



f Sh th pp ra f th t m h p tlv c d (khab) t d f m p t



Fig 8 C 4 Sh th l c t f th t m (d mm t)

factorily controlled and the number of silver clips or ligatures which must be used has been reduced to the minimum

I have not however always had perfect success in sealing by coagulation large arteries on the surface of the cortex and have still found it necessary before incision of the brain with the electric knife to apply ligatures or silver clips to larger cortical arteries which have to be divided. It has happened to me at times that a vessel of some size which appeared to have been well sealed before it was divided began to bleed later so that a silver clip had to be applied secondarily.

This occurred in the following case in which a tumor was excised which was located in a temporal lobe and extended to its under surface

CASE 3 MSH 96668 woman of 40 years admitted that a temporal tumor had existed for 6 weeks duration. The headache was severe and was on the left side of the head. The chief symptom pointed to the tumor in the right temporal lobe. A physical examination of the head showed that the tumor was in the right temporal lobe. A large flap was raised and the dura was opened. The posterior part of the right temporal lobe was removed. The tumor was found to be a large, firm, white mass. The tumor was removed and the dura was closed. The patient recovered well.

Incision

Discolored

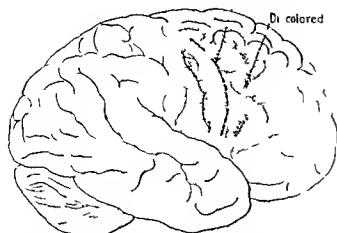


Fig 9 A Case 5 Showing the location of the incision (diagrammatic)

under the pia arachnoid and left this part of the field less clear than one would have liked it to be. The cortex was then incised all around the tumor. A mass 4 by 4 by 2 centimeters was first excised and two small cysts opened. With the loop more and more of the growth was excised without bleeding down to the floor of the temporal fossa. In the depth another large vessel was seen and again the attempt was made to close it off with the coagulating current. Again bleeding occurred which had to be controlled by the insertion of a small piece of muscle. At the conclusion of the tumor removal the walls of the large cavity fully 5 to 6 centimeters in depth seemed to be formed of normal brain tissue excepting posteriorly where the bleeding which had occurred from the first large cortical vessel that had been divided had so changed the appearance of the brain that it was difficult to determine whether one was dealing with tumor tissue that had not been removed or with hemorrhagic cortex. This area was therefore thoroughly cauterized with the coagulating current before the cavity was filled with saline solution the dura closed and the bone flap replaced.

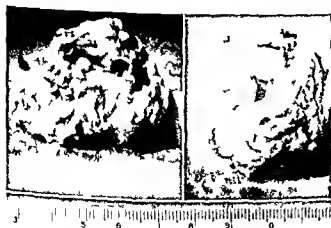


Fig 11 Case 5 Showing the tumor removed at the operation

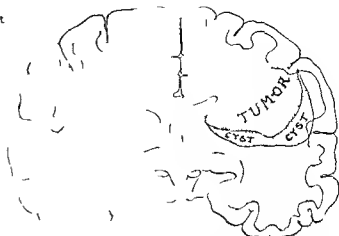


Fig 10 Case 5 Showing the location of the incision and the tumor and cysts (diagrammatic)

The patient had been ill more than 3 hours and the tumor was 1,500 cubic centimeters of citrate. After the operation he was returned to her bed. She remained entirely uncomplicated the first 24 hours after the operation. The other symptoms rapidly disappeared the pupillary reflexes and homonymous field defects improved markedly after the operation (Figs 5 and 6).

In the following case the value of electro-surgery was clearly demonstrated and during the process of extirpation of a vascular growth from the left temporal lobe the bleeding was at all times perfectly controlled.

CASE 4. I.H. 84060, a merchant 46 years of age referred by Dr. Frederick Tilney gave a history of headache and speech disturbances of 5 months duration. Upon his admission there was found complete sensory aphasia, marked mental disorientation.



Fig 12 Case 5 The appearance of the patient 2 weeks after operation

right pyramidal tract disturbances and slight signs of increased intracranial pressure.

January 1, 1929. Under novocain anesthesia a large bone flap was elevated on the left side. In the temporal lobe a cyst which contained 20 cubic centimeters of xanthochromic fluid was emptied and the cavity washed with formalin solution. The middle part of the left temporal lobe was occupied by a infiltrating growth and considerable bleeding which occurred when a small fragment was removed for histological examination had to be controlled by the use of pieces of muscle. As the electrosurgical apparatus was not available at the time the wound was closed for the time being.

Ten days later the flap was again elevated and the dura widely opened. The growth was found to occupy a large part of the temporal lobe. After large cortical vessels had been ligated incisions were made in what appeared to be normal cortex all around the growth. With the electrified loop scalp tumor was removed until no more neoplastic tissue could be seen. The amount of tumor containing lobe that was excised measured at least 4 centimeters in depth and 6 centimeters in depth (Figs. 7 and 8) and during the tumor removal two small cystic cavities were opened and yellow fluid evacuated. The walls of the large cavity were sprayed with the dehydrating current before the cavity was filled with salt solution the dura partially lifted and the flap replaced and sutured.

During the entire procedure there was practically no bleeding. The patient's recovery was uneventful and he was able immediately to walk both on his right side and in his speech. Eight days after the operation he was speaking entire sentences and at the time of this writing 6 weeks after operation his speech has still further improved.

As this case demonstrated electrosurgery is of the greatest value for the extirpation of gliogenous growths and with a good electrical apparatus much time is saved in the control of bleeding but these growths can be removed even without it as was shown by the following experience.

CASE 5. N. B. 16307 H. concerned a bank cashier 25 years of age who had his first convulsion 9 months before. The attack which was Jacksonian type affected the left face and left upper extremity and recurred at regular intervals. Fifteen months after his first seizure he began to lose position in the left upper and later in the left lower extremity. Four months before his admission to the neurological institute he had headache, vomiting and temporary obstructions of vision. He was found to have a high grade of papilledema, a left supranuclear facial weakness, almost complete loss of power in the left upper and some weakness in the left lower limb.

At the operation under local anesthesia the cortex of the binder part of the right frontal lobe was yellow in color and bulging and by aspiration a small amount of xanthochromic fluid was withdrawn. After cortical vessels had been ligated a wide incision was made in the frontal lobe (Fig. 9A) and at a depth of 2 centimeters a grayish tumor mass was exposed. With the finger a rather firm lobulated tumor could be felt which merged gradually into normal brain tissue. The tumor was progressively freed partly by incision of the brain tissue partly by wiping brain away from the growth with cotton pledgets. At various times larger blood vessels were encountered and had to be ligated. During the procedure yellow fluid was evacuated from two cystic cavities (Fig. 9B). Before the growth a 45 g m astrocytoma (Figs. 10 and 11) could be entirely removed the lateral ventricle was widely opened. An area of changed cortex mesial to the tumor was excised and the entire cavity filled with saline solution.

At the close of the operation there was a distinct return in power of the left face and arm. When he left the hospital 4 days after the operation the power in the left upper extremity was as good as that of the right and the weakness of the left side of the face had almost disappeared (Fig. 12). He has remained well up to the present time—4 months after the operation.

There is one clinical feature of the astrocytoma which deserves especial mention. In these patients many of the neurological disturbances are due predominantly to the local pressure of the growth so that rapid improvement will occur as soon as the neoplasm has been removed and the fluid contents of the cyst evacuated. Motor power that has been lost may be quickly regained sensory disturbances disappear field defects rapidly recede and speech difficulties steadily improve. Although this quick improvement is especially noticeable when the new growth has been excised the immediate result of the evacuation alone of the fluid contents of a cyst may be similar—a rapid recession of many disturbances. However unless the solid part of the growth has been radically removed a mural nodule and the lining membrane of the cyst completely extirpated there will be a recurrence of symptoms sooner or later. Fixation and cauterization of the lining membrane of a cyst with Zenker's or with formalin solution may be very useful and in some instances this is all that can be done. I have become more and more dissatisfied however with the



Fig. 13. Case 6. Showing the bulging tumor after incision of the left cerebellar lobe and worm (Elaborated from original sketch).

final results in patients in whom when no mural nodule could be found this procedure was carried out and am convinced that whenever possible the lining wall of a cystic cavity should be extirpated or completely destroyed by electrocauterization.

In posterior fossa tumors the primary relief of pressure upon the aqueduct and fourth ventricle by the evacuation of cyst fluid and the wide opening of the dura will again permit the normal circulation of cerebrospinal fluid out of the ventricular cavities and the improvement which will follow such a procedure is often marked and may last for a number of years. I have for example seen complete relief of symptoms for 6 years after suboccipital decompression with simple evacuation of the fluid contents of a cyst deep in one cerebellar lobe. Recurrence however usually occurs within 1 to 2 years and such an operative procedure must in the present state of intracranial surgery be considered inadequate and incomplete.

CASE 6. NIB 16279H. A schoolboy, 9 years of age, had suffered from attacks of headache and vomiting for 2 years following a bilateral otitis media and an operation for mastoid disease. For 6 months before his admission the attacks became more frequent and he began to walk unsteadily. He was admitted into the Neurological Institute with the fully developed symptoms and signs of a left cerebellar expanding lesion and a suboccipital craniotomy was done. The first operation had to be stopped before the dura was opened on account of his poor con-

dition. At the second operation one week later the dura was widely opened the left cerebellar lobe was incised and at a depth of 1 centimeter a very vascular tumor was exposed. Again the boy's condition became so poor that the wound had to be closed for the time being and 4 weeks had to intervene before his condition permitted of further surgical procedures.

The suboccipital wound was then reopened a second time and with the electric scalpel an incision 4 centimeters in length was made in the left cerebellar lobe. The infiltrating tumor was then removed piecemeal with the electric loop until all visible neoplastic tissue had been taken away and a cavity 4 by 4 centimeters was left which extended deeply into the lobe and mesially into the superior vermis. The bleeding during the procedures was



Fig. 14. Case 6. Shows the large cavity left after excision of the tumor with the electro-surgical knife (Elaborated from surgeon's operative sketch).

Fig. 1

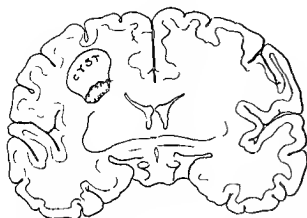


Fig. 1. A coronal section of the brain showing a tumor (CTST) in the left hemisphere.

each contained with the lehyd atig and coagulat
g cu ent The four th ventr cle as n t opene l
1 to but onl a very thin tra lucent layer of cerebel
lar ti ue a left n the side of the four th ventricle
(fig 13 n l 4)

The patient thstood the surg cal p cedure bet
te than any of the previous operations He v s dis
ch gel o d v later feeling ell h s discs pra ti
all flat no ystagnus very litle taxia The
tumor a rb ut 3 by 3 cent mete ins e and was
a t pic lastr cytoma

In operations in the posterior cranial fossa
the change brought about by the use of
electrosurgery has been very striking Not
only can much more radical procedures be
carried out than were possible with the or
dinary surgical armamentarium not only is
the prevention as well as the control of
bleeding much more satisfactory but the
amount of trauma done to the brain is greatly
diminished Cotton pledgets and wall offs
cannot be entirely dispensed with but their
use has become greatly restricted Especially
is the frequent wiping of the cut surface



Fig. 2. A brain specimen showing the characteristic folded surface.

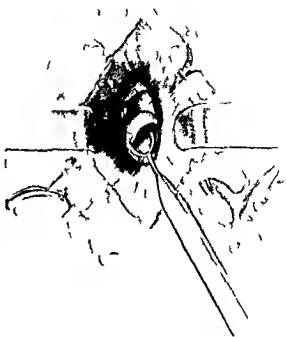


Fig. 3. A surgical procedure on a brain, showing a large incision and the use of a surgical instrument.

of the brain (each wiping no matter how
gently done means a trauma to the nervous
tissue) reduced to the minimum As a direct
result added disturbances observed after the
operation are very few and often there is none
at all This has been very noticeable after
extensive resection of the cerebellum by
means of the electrosurgical apparatus We
have again and again noted both with sur
prise and with gratification that cerebellar
symptoms were no more and not rarely dis
tinctly less marked after an extensive inci
sion into or resection of a cerebellar lobe

We now consider the electric knife an almo t
indispensable aid for the exposure and re
moval of infiltrating growths no matter how
deeply subcortical they are situated As
already mentioned the division and excision
of brain tissue can be done with considerably
less trauma than by the methods used here
tofore and the excavation of the central parts
of a growth before the shell is excised makes
po sible and easier the radical removal of the

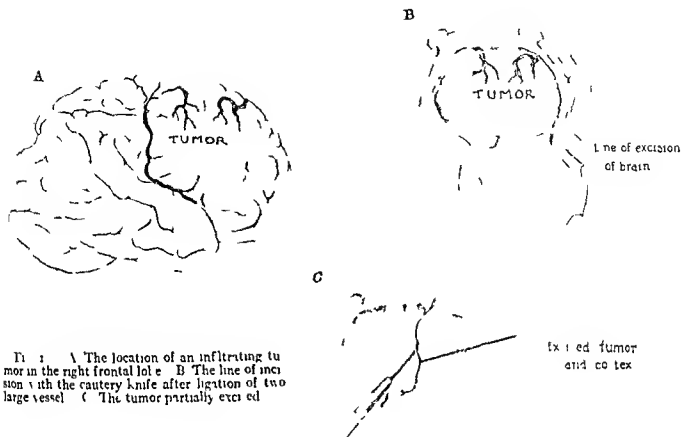


FIG. 1. A The location of an infiltrating tumor in the right frontal lobe. B The line of incision with the cautery knife after ligation of two large vessels. C The tumor partially excised.

outermost parts. If one is dealing with a cyst and a smaller or larger mural nodule (as shown for example in Figs 15A and B) the incision into the cyst is accomplished with ease and the mural nodule can be removed *in toto* or in pieces with the electrified loop. The cases described in this paper are typical examples of experiences and methods which will be fully dealt with in a future report.

As already indicated it is my impression and this may be due to lack of experience that thin walled veins of large size can be much more satisfactorily sealed off with the dehydrating and coagulating current than can arteries of the same size. Even if some brain tissue is picked up with the forceps on each side of the vessel it is sometimes very difficult no matter how carefully the current is regulated to apply just sufficient current to seal off the artery and to form a coagulum of both the artery and a small area of tissue which surrounds it without causing so much tissue destruction that bleeding will recur or that there will be danger of a secondary bleeding—

perhaps hours or days later. In one patient I feel certain that a fatality after the clean removal of a meningioma which had arisen from the dura of the sphenoid ridge was due to secondary bleeding from a large vessel on the dural attachment of the growth.

In the removal of large vascular tumors I have found it advantageous to make deep incisions with the electrified loop on four sides of the central part of the growth. As the part of the growth between the four lines of electrical incision and cauterization has been deprived of practically all of its blood supply this part of the growth can be scalloped out quickly without fear of bleeding from any larger vessel. This procedure has the added advantage that the scooping out with the electric loop can be more satisfactorily accomplished as the field is practically dry. The live electrode works much better both for dehydration and coagulation as for cutting purposes when the field is dry.

Realizing that the use of the hand pistol grip supplied with the Bovie machine deprived



Fig 18 Photograph of the tumor removed in the patient illustrated by Fig

the operator of the necessary delicacy of manipulation which is so often necessary. I at first tried the foot switch which is supplied with all forms of electrical apparatus. It was found to be very disturbing to the operator to have to divert his attention to the foot switch whenever the current was to be turned on. Following the suggestion of one of the members of our staff we have interpolated an assistant between the operator and the person who runs the machine and changes the character and strength of the current. This assistant who stands behind the operator and can see the operative field holds the pistol and switches the current off and on whenever desired. In the interim the assistant is useful in holding the pencil whenever the operator is not using it. This entirely relieves the operator of switching the current and makes it necessary only for him to receive the pencil from the hands of the assistant when he desires to use it. This assistant also can with the pencil shoot the current through the forceps on a blood vessel which is to be sealed.

When the electrified knife or loop is being used to scallop out pieces of tumor the removal of the scallops of tumor or of charred tissue from the loop or electric scalpel is often somewhat bothersome. The charred tissue clings to the electrode and has to be wiped off

so that the active electrode can again be used. For cleansing purposes we have found a small ball or pad of fine copper ribbon such as is used for cleaning pots and basins very useful (Fig 16). This was suggested and obtained for me by Dr Klenke and was found superior to the wire waste supplied with the Bovie apparatus. The copper wire ball can be sterilized by boiling with the instruments.

Time is lost however each time charred tumor tissue is wiped off of the active electrode. I am now having made for me a double pistol and double cable so that two pencils each holding an electrode will be at hand. The current can be switched on or off in either pencil by the assistant who manipulates the pistol grip so that the electrodes can be used alternately.

The incisions in the brain and the excision of tumors or of brain tissue with the electric scalpel must be done as cleanly as if an ordinary knife were being used (Figs 17 and 18). The coagulating and cauterizing current should be used only when the surgeon desires to destroy superficial tissue in the area in which he is working either the lining membrane of a cyst which cannot be excised or a layer of tissue in which some tumor cells may be remaining or where the current is being used to stop bleeding from an oozing surface. To use the current in order to burn out a part of the brain which contains tumor tissue will lead to ineffectual work and will surely give results which will not be satisfactory.

No doubt each surgeon who uses an electrosurgical outfit will devise means and methods of his own to simplify as much as possible the operative manipulations. The future will see many changes both in the apparatus and in the ways of using it. This much seems however certain. The methods for the removal of infiltrating tumors of the brain have been fundamentally advanced by the use of electrosurgery and much progress will be made in the next few years. Not only will the operative results in the benign type of glioma be greatly improved but one may dare to hope that much will be accomplished in the most malignant type of brain tumor—the spongioblastoma multiforme.

A GENERAL CONSIDERATION OF CAESAREAN SECTION¹

C JEFF MILLER M.D. F.A.C.S. NEW ORLEANS, LOUISIANA

IT is one of the paradoxes and one of the tragedies of medicine that certain measures designed primarily as life saving and health giving should carry in their abuse death and invalidism. Cesarean section is of this group. Originated for the salvation first of the child and then of the mother, all too frequently it has become a death dealing agent for them both. On the surface it does not seem unreasonable to set as a minimum requirement that both mother and child should survive, alive and well, an operation done for the purpose of saving them both, yet even this minimum is not fulfilled by a maternal mortality ranging from 2 to 25 per cent and higher, or by a fetal and infant mortality of from 2 to 30 per cent.

Cesarean section, as Table I shows, is by no means the simple and safe procedure it is popularly supposed to be. These are casual figures collected quite casually from the literature and for that reason they are representative figures. The mortality of the average operator and the average mortality of all operators are much truer indices of the value of a given procedure than are the brilliant results of a single skilful surgeon or a single well organized clinic. Cesarean section by this test is plainly a dangerous measure and dangerous measures it goes without saying can conscientiously be invoked only when it is quite clear that no other less potentially harmful methods will achieve the required results.

There are many reasons for this fearful mortality. First of all and possibly most important of all we have today an entirely wrong conception of the processes of parturition. The basic purpose of obstetric art may be to extract the child, but in these days we are in danger of forgetting that the method is quite as important as the act itself. Other things being equal, the mechanism of a normal labor is still very much better from every angle than any of the improvements we have found for it, and there are still those among

us old fashioned if you will, who feel a degree of satisfaction when a woman gives birth to her child by her own unaided efforts. Obstetrics is still a specialty in itself, not an adjunct of general surgery, and the lives of parturient women and of their children, for that matter, are not safe in the hands of men who so regard it. The birth canal as Lindley says is something more than a makeshift exit to be used only when the surgeon is otherwise engaged, and Williams is equally right when he points out that since every justifiable obstetric operation represents a failure on the part of nature, it behooves us to take due care that it does not represent a failure on the part of our intelligence also.

The second reason for the high mortality of cesarean section is that the type of obstetric training which is given today in most of our medical schools is frankly of a very poor sort. The bulk of obstetrics in this country always has been and probably always will be done by the general practitioner. He more than other physicians must know something of everything, and it is too much to demand that he should be a thoroughly trained obstetrician. It is not too much, however, to demand that he should be at least trained to recognize his own limitations and equally important to recognize them while other counsels than those of despair are still possible.

The consulting obstetrician, for some reason is not a popular figure in American medicine. Let it be granted that he makes his full quota of mistakes. At any rate whatever the reason, the consultant of the general practitioner is most often a general surgeon who is even less trained in the refinements of obstetric diagnosis and technique than is his confrere who has summoned him. His first instinct in any emergency is to do what he knows how to do best, with the result, as Newell says, that the patient is treated according to the limitations of her attendant. He can do abdominal surgery even if he cannot do intrapelvic operations, or if, as would

TABLE II — MISCELLANEOUS INDICATIONS
QUOTED VERBATIM

| | |
|-------------------|------------------------------------|
| Inertia | Laparotomy one year ago |
| Dystocia | Children in rapid succession |
| Exhaustion | Wrecked health |
| Obstruction | Arthritis ankle |
| Osified symphysis | Varicose veins |
| Anencephalus | Patient's personal desire |
| Hydrocephalus | Patient's desire for sterilization |
| Adhesions | Epilepsy |
| Abdominal pain | Low grade mentality |

TABLE IV — INCIDENCE OF SPONTANEOUS
DELIVERIES IN PELVIC CONTRACTION

| | N | mb | P
per
del | t g |
|--------------------|------|----|-----------------|-----|
| Montreal Maternity | 1462 | | 75 | 5 |
| St. Louis | 316 | | 11 | 8 |
| Williams | 2975 | | 78 | 0 |

TABLE V — COMPARATIVE MORTALITIES IN
ECLAMPSIA

| | M | l | C | a | c | M | t | l |
|--------------|----|----|---------------|---|---|----|---|---|
| | pc | ty | | | | p | | t |
| Chantry 927 | 13 | 0 | Bride | | | 66 | 6 | |
| Dorsett | 3 | 3 | Fden | | | 46 | 0 | |
| King | 8 | 8 | Engelman | | | 26 | 0 | |
| Rotunda | 12 | 5 | E. sen Moller | | | 30 | 0 | |
| Spalding | 8 | 9 | Holland | | | 31 | 8 | |
| St. O. anoff | 2 | 6 | New Orleans | | | 41 | 9 | |
| William | 10 | 3 | I. efer on | | | 34 | 8 | |
| Ilem | 3 | 0 | Welz | | | 42 | 0 | |
| | | | Williams | | | 24 | 0 | |

TABLE III — VARIOUS INDICATIONS OF
CÆSAREAN SECTION

| Hospital | Rate | Indication |
|---|----------|------------|
| Bellevue | 1 to 9 | |
| Boston Lying In | 1 to 12 | |
| Burnside | 1 to 86 | |
| Detroit | 1 to 217 | |
| Jefferson | 1 to 6 | |
| Cook County | 1 to 88 | |
| Long Island College | 1 to 125 | |
| Melbourne Woman | 1 to 103 | |
| New England Hospital for Women and Children | 1 to 102 | |
| New Orleans | 1 to 52 | |
| New York Lying In | 1 to 585 | |
| Potters | 1 to 14 | |
| Rotunda | 1 to 19 | |
| Sloan | 1 to 36 | |
| San Francisco | 1 to 40 | |
| Swedish | 1 to 201 | |
| University College | 1 to 11 | |
| Johns Hopkins | 1 to 77 | |

his students that anybody with two hands and a few instruments can do an abdominal section but that it takes a much higher degree of intelligence to refrain from doing one and to predict a normal labor in a given borderline pelvis.

Certainly routine section is not indicated. There must be in each case a careful study of the pelvic measurements, the size and shape of the cavity, the size of the child, the size and type of its head and finally of the force of the pains of labor if a decision cannot be come to without that knowledge. The first pains unfortunately are of little value in gauging the final character of the labor and as Reynolds pointed out thirty years ago the danger of section increases proportionately with the increasing value of the test. The introduction of the low cervical technique however has recently made a properly con-

ducted aseptic test a relatively safe affair and adequate prenatal care will eliminate most of the unhappy case in which a wrong decision has been made and in which craniotomy is the only safe retreat. A rather wider use of that loathesome operation it might be added would mean more living mothers and ultimately other better managed pregnancies for them while an added justification lies in the fact that in practically every average series of cesarean sections the mortality is a dual one in from a quarter to a third of all fatalities.

It might be well in view of the present tendency to exalt the child's life at the expense of the mother's to consider what our course should be when that conflict arises. Of course it should not arise, the ideal of obstetrics is to save two lives not to evaluate them against each other. But this is an imperfect world, the situation must sometimes be faced and for my own part, if the choice is mine alone I do not hesitate. If the woman is a primipara her present child must be sacrificed to her future generative possibilities. If she is a multipara with living children her present child must be sacrificed to her existing responsibilities. And under no circumstances be she primipara or multipara should her life be jeopardized for the sake of

TABLE VI —COMPARATIVE MORTALITIES IN PLACENTA PREVIA

| Co | t | m | M | l | t | C | M | t | S |
|---------------------|----|---|---|-----|---|-----|----|--------------|---|
| S | ie | p | t | E | n | M | ie | t | S |
| Bourne | | 5 | 9 | E | n | M | ie | t <td>S</td> | S |
| Bl ck | | 7 | | H | t | chm | ie | t <td>S</td> | S |
| DeN rmande | | 4 | | H | o | nd | ie | t <td>S</td> | S |
| H t chm n | | 6 | | New | O | l n | ie | t <td>S</td> | S |
| J flett | | 3 | 6 | | | | ie | t <td>S</td> | S |
| Wh tehou | | 4 | 2 | | | | ie | t <td>S</td> | S |
| I l d g l l m th ds | | | | | | | | | |

TABLE VIII —VAGINAL DELIVERIES AFTER CESAREAN SECTION

| S | N | mbe | N | mbe | N | mbe |
|---------|-----|-----|----|-----|-----------------|-----|
| ie | as | d l | ie | as | d l | ie |
| Bnd | 94 | 3 | ie | as | d l <th>ie</th> | ie |
| Gl dd | 2 | | ie | as | d l <th>ie</th> | ie |
| H lland | 448 | 96 | ie | as | d l <th>ie</th> | ie |
| Ker | 8 | 2 | ie | as | d l <th>ie</th> | ie |
| Ri e | 13 | 36 | ie | as | d l <th>ie</th> | ie |
| W lson | 33 | 4 | ie | as | d l <th>ie</th> | ie |

TABLE VII —ESTIMATED INCIDENCE OF RUPTURE OF SCAR

| S | N | mbe | P | t | g |
|---|------|-----|----|---|---|
| ie | as | | | | |
| C elia | 5 | | | | |
| D | 36 | 2 | 5 | | |
| I ss n M l l | 32 | | | | |
| C mbl | 63 | 5 | | | |
| Idem | | 5 | 5 | | |
| Ha | 5 | 4 | | | |
| H l l d | 448 | 4 | | | |
| Id m | 96 | 8 | 75 | | |
| N y | 6 | 86 | | | |
| N U l an | 6 | 7 | 5 | | |
| W tt l d | 3600 | 003 | 1 | | |
| W l n | 33 | 3 | | | |
| Id m | 40 | 5 | | | |
| I l f l h o s w h h f u m p t t f f l d h r y | | | | | |
| t l d g l p by l r l h q | | | | | |

TABLE IX —REPRESENTATIVE MORTALITIES OF LOW CERVICAL OPERATION

| S | N _{rub}
as | M
pe | tal y |
|-------------------|------------------------|---------|-------|
| Buley | 57 | | |
| Ba m | 133 | 5 | |
| Brnd u | 88 | 0 | |
| D nf th nd G e | 5 | | |
| DeLee | 6 | 96 | |
| G h ll | 43 | | |
| H fm et l | 94 | 5 | |
| New O l n | 55 | 5 | 42 |
| S l | 3 | 5 | 4 |
| Stein d Le enthal | 4 | 0 | |

the majority of women particularly in public hospitals are seen only when infection is decidedly more than a possibility and that the child for whom they plead so eloquently is already jeopardized by the maternal disease and in at least half of all cases is premature sometimes to the point of not even being viable

a child whose chances no matter for what reason are in any way dubious

To return to the indications for cesarean section eclampsia does not belong in the list. The comparative figures of Table V show that it is better handled by almost any other method. Obstructing tumors are an absolute indication though a rare one for fibroids most often rise out of the pelvis and permit spontaneous delivery and ovarian cysts are best handled during pregnancy by laparotomy. In selected cases placenta previa is undoubtedly a justifiable indication but again comparative figures (Table VI) show that cesarean section is not warranted as a routine treatment. Conservative measures give better results and it has been repeatedly pointed out that the fact that section in the hands of a competent surgeon gives better results than conservative treatment in the hands of a tyro has nothing to do with the case. A tyro has no right to be treating a complication of such gravity. The advocates of routine section fail to realize two things that

Among the group of miscellaneous indications the name of which in this day is legion certain ones are frequently perfectly justified others are never warranted unless there is a coincident absolute or relative indication. Individualization of all patients is desirable indications are necessarily and rightfully elastic but certain abiding principles must remain and in doubtful cases the invocation of one's obstetric conscience if it has not gone into the discard along with other old-fashioned things of like ilk will end in action which is simplest for the patient though not necessarily for her accoucheur. His convenience however can scarcely be ranked as a justifiable indication.

The performance of cesarean section by no means terminates the surgeon's responsibility. Once he has done it he has charged to his account that woman's obstetric future and he is responsible at least morally for what

happens to her in her subsequent pregnancies The scar is always a hazard as long as she is able to conceive and since Gamble's disturbing investigation we have no definite criterion by which to estimate its strength We do not know, as Table VII shows, what the exact percentage of rupture is nor even more important do we know when it is likely to occur The accident is a possibility any time after the seventh month¹, and the intervention of a natural delivery, or of several for that matter confers no form of immunity

Even though it means inconvenience and expense which sometimes can be ill afforded all such patients must be delivered in hospital When the indication is absolute naturally the operation must be repeated, and the general custom is still to do a second section if the first has apparently been associated with infection even though Gamble's study has proved that the mere absence or presence of febrile manifestations is not a true criterion of the integrity or the weakness of the cicatrix Otherwise if I were sure of the aseptic technique of the first operation I should be inclined to give the patient the test of labor watching her scrupulously, and delivering her with forceps when the head had reached the spines Her chances as Table VIII shows are probably as good as they would be with repeated section and its inevitable mortality

The fact that even the most facile advocates of cæsarean section are ready to discuss with their patients the question of sterilization is another proof albeit an unconscious one of the dangers of the operation For my own part I consider that a woman who bears her children in this fashion submits to such a real risk that I would be derelict in my duty if I did not point it out to her Naturally I will not sterilize her at her first section unless some serious organic indication exists, but I will do it upon request at the second section and I urge it upon my own initiative at the third

To speak briefly of technique the classical operation is never safe late in labor for no suture line is water tight and no amount of packing can lessen the danger of the intra-

peritoneal spill of uterine contents which, at this stage are never sterile I have had no personal experience of the Portes operation but in spite of its ingenuity it seems to me to be of dubious anatomic basis and to take little regard of the manner in which infection spreads The Porro operation gives unequalled results but it is a frightful price for a young primipara to pay on the chance that she may develop a serious infection

If section must be done when labor is advanced laparotrachelotomy popularized in this country by Beck and DeLee is the most satisfactory technique available The wisdom of its principles has been established by the demonstration by Hofbauer of the protective cellular mechanism in the broad ligaments and the technique offers no difficulties to an experienced surgeon though it is most empirically not a procedure for the beginner Comparisons with the classical operation are worth nothing unless circumstances could be correlated exactly which is obviously impossible but the figures of Table IX which include a very large percentage of actually and probably infected cases may stand upon their own merits Rupture of the scar too is less likely with this technique because the incision is in the lower segment which is the resting non involuting part of the uterus during the puerperium and which plays a late and passive part in the stretching incident to pregnancy and labor

Such then is the present case of cæsarean section An operation designed as a life saving measure has become a sort of medical boomerang carrying with it a mortality which since it is so largely avoidable is criminal rather than tragic During the last seven and a half years for instance 15 per cent of the parturient deaths at Charity Hospital in New Orleans occurred after its performance as did 26.6 per cent of the parturient deaths at Tourou Infirmary and I have no idea that these figures are unique A life saving measure which implies a mortality such as this should be invoked only after it has been clearly established that no other method will serve the needs of a given situation as well or indeed serve it at all In that sense rather than in its present desperate significance cæsarean

¹ In the case of a woman who has had a previous cæsarean section, the risk of rupture of the scar is not negligible. The risk is not negligible in the case of a woman who has had a previous cæsarean section. The risk is not negligible in the case of a woman who has had a previous cæsarean section.

section should be a last resort operation deliberately undertaken only because other measures have been duly considered and have been honestly and conscientiously rejected as not serving the best interests of the mother and of her unborn child

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PRIMARY CARCINOMA OF THE LIVER IN CHILDHOOD

EDWARD J KILFOY BS MD LOS ANGELES CALIFORNIA

AND

M C TERRY MD HINES ILLINOIS
F I D H J H P I I

PRIMARY carcinoma of the liver is uncommon at any age and extremely rare in childhood there being only a few authenticated cases in medical literature. By authenticated cases we mean those in which postmortem examination and microscopic study are adequate to establish the growth as primary in the liver and not secondary to carcinoma in the rectum stomach pancreas and adrenals. Incompletely authenticated cases are more numerous but even when these are included as in the extensive articles by Eggel and Karsner (9) the total number accessible in the literature is small. For this reason we wish to report a case that recently came under our observation in which in addition to the postmortem examination and the microscopic study we have the clinical history from the child's birth to her death at the age of 9 years.

Dansie states that the lesion is so rare that one does not consider the possibility of carcinoma until he is confronted with the condition at the postmortem table. Castle reports that White found only 11 cases in 11,500 postmortem examinations. Virchow found 6 cases in 6,000 postmortem examinations. White states that 'hepatic cancer' is all but unknown before the age of twenty. Rolleston says that primary malignancy at any age is so rare that scrutiny must be employed at the autopsy in order to prove that it is not secondary with the primary growths at some distant locations such as the rectum the stomach and the pancreas. At Guy's hospital (18) of 18,500 autopsies only 4 cases are reported and they were of all ages.

Phillips reports primary carcinoma of the liver proved at autopsy and by microscopic sections by the following: Kottmann Wulff Pye Smith Birch Hirschfeld Engelhardt Ackland Dudgeon Schlesinger Grawitz Burt Plant Lubarsch Matthiolo Weaver Karsner (10), Mair Castle Picot Prescott

Wollstein and Missell (19). Phillips reports 17 probable cases. In many instances in Phillips cases the reports do not show autopsy findings or microscopical study. No doubt cases have occurred and have not been reported in the literature. There are reports of cases in adults but not in children.

RESUME OF REPORTED CASES

In 1907 Phillips collected 29 cases from the literature reporting no new cases. Twelve of these cases he reported as authenticated. Seventeen of the 29 he classified as doubtful. In 1914 Castle brought the total up to 42 cases. He included the cases reported by Phillips as well as some of more recent date and added one new case of his own. Table I shows all cases reported to date (44) including our case and that of Wollstein and Missell and may be summarized as follows:

The ages vary from 1 day to 16 years the average age being 5.8 years. The sex incidence is male 16 female 19 not known 9. In Cases 1 to 10 the diagnosis was doubtful. Cases from 17 to 38 were proved by clinical history autopsy and microscopical sections to be cancer of the liver. Cases from 9 to 43 were collected from the literature and many did not give the autopsy findings or a report on microscopical sections.

AUTHORS CASE

L. L. female aged 9 years the daughter of a physician complained chiefly of a mass in the right upper quadrant malnutrition and anaemia. The father aged 41 years is living and well the mother aged 39 years is also living and well as is one brother aged 13 years. The paternal grandfather died of diabetes. The family history revealed no lues tuberculosis nephritis or blood dyscrasias. Patient was a full term child of normal pregnancy and normal delivery and was breast fed until she was 13 months old. At the time of birth she weighed 3 pounds and 14 ounces. She had always been a delicate child. The father states that they had always

noticed that the child had a large liver and prominent veins about the umbilicus. She never had been robust at any time and had always been undernourished. Infant had measles at 3 years diphtheria at 7 years. She had a bilateral herniotomy in 1922.

As the child had never been strong and as she was undernourished she was placed under the care of a private nurse to try forced feeding to build up her general condition. In caring for the child's toilet the nurse noticed a mass in the region of the liver to which she called the parents' attention. The child was immediately taken to numerous physicians and many different opinions were given. At this time there was no jaundice, pain or colics. Loss in weight and dehydration were prominent.

Her appetite had always been poor. Nutrition was poor for a child of her age. She had no diarrhoea and the faeces showed no blood or mucus. The bowels were regular. No symptoms referable to the kidneys, ureters or urinary bladder were found. Her weight was 40 pounds, temperature 100 degrees F, pulse 80, respiration 20. Dehydration was estimated as on a basis of 4. The tonsils were not enlarged or infected. The teeth were very good. The neck was essentially negative. Examination of the heart showed a loud apex, rapid loud clear irregular. Other heart sounds were the same. The lungs apparently were negative. The abdomen was markedly distended and a large hard irregular mass filled the upper right quadrant and epigastrium extending down to the crest of the ilium. The mass moved with respiration. It was not tender or painful on palpation. The edge of the mass was rounded and easily palpated. No free fluid was demonstrated in the peritoneal cavity. The spleen was not palpable. The neuromuscular system showed atrophy of disuse. Urinalysis showed the urine clear and negative for albumin, sugar, acetone and pus. On several occasions a few pus cells only were found. The blood count showed hemoglobin 70 per cent, red blood cells 4,000,000, white blood cells 8,900, small lymphocytes 1 per cent and polymorphonuclear 67 per cent. Wassermann reaction was negative. Cystoscopy examination was made on September 2, 1927. The cystoscope was passed easily. The urinary bladder appeared normal. No tumour, ulcerations or diverticula were disclosed. The ureteral orifices were easily seen and urine could be seen ejecting from them freely and regularly. A No. 5 ureteral catheter was easily passed into the right kidney pelvis and a pyelogram was made. It showed the right kidney pushed down by the mass. The left kidney was negative. A roentgen examination of the chest was negative. A roentgen examination of the colon disclosed no definite abnormal condition.

Clinical diagnosis: no growth of the liver type questionable malnutrition secondary anaemia.

Exploration was considered but the child was removed from the hospital and exploration was refused. The child gradually lost weight and strength

and she became jaundiced. During the interval at home the child was given 13 deep X-ray therapy treatment of 15 minutes each and 25 milligrams of colloid of lead. These were of no value in reducing the size of the mass. Ascites developed and on December 30, 1927, the abdomen was tapped and 1,450 cubic centimeters of bright yellow crystal fluid was withdrawn. The jaundice continued to increase in degree and the child died on February 5, 1928.

Autopsy revealed a female child apparently 9 years of age, length 118 centimeters, weight approximately 25 pounds and skin markedly icteric. The pupils were round, regular and dilated. Enlargement of the abdomen was marked as were emaciation and dehydration. The superficial veins over the abdomen were dilated and prominent. Two herniotomy scars were present in the inguinal triangles and a trocar wound in left lower quadrant. There were no pleural adhesions. The heart was in normal position. No fluid was present in the pleural cavities. The pericardium was free. The pericardial sac contained 15 cubic centimeters of clear straw colored fluid. The heart weighed 17 grams. The external surfaces of the heart were smooth but had an icteric tinge. The aorta as normal. Inspection of the valves showed them to be smooth and intact. The aortic cardiac valves and heart muscles were somewhat atrophic. The oesophagus and trachea were definitely icteric otherwise negative. The thymus was small and atrophic. The thyroid was not disturbed. The lungs were light pink in color and floated in water. The surfaces were studded with yellowish white nodules measuring from 0.5 to 3.0 centimeters in diameter (Fig. 3). The largest were found on the under surface of the left lobe. Numerous large intralobular metastases were found. Both lungs were aerated and showed no consolidation. The bronchi were somewhat icteric otherwise negative. When the peritoneal cavity was opened a large nodular liver presented with the escape of about 180 cubic centimeters of dark green colored fluid. There were numerous omental adhesions to the liver gall bladder and right kidney area. The omentum was very thin and devoid of fat. The spleen weighed 2 grams and was smooth. The capsule stripped easily. Cut section revealed marked congestion, splenic substance firm. The malpighian bodies were prominent to the naked eye. The stomach was not dilated. It contained 10 to 15 cubic centimeters of gastric secretion. The mucous membrane was pale and intact throughout. No scars were found at the pylorus. The examination of the duodenum revealed nothing abnormal. The mucous membrane of the small bowel was thin and injected in places but no ulcerations could be seen. The appendix was normal. The gall bladder measured 5 centimeters in length and was moderately distended, thin walled and contained 0.5 cubic centimeters of dark brown solid particles which were semi soft under the pressure of the finger. There were no definite hard stones. The cystic and common ducts were patent.



Fig. 1. Shows anterior superior aspect of liver.



Fig. 2. Shows the head of the pancreas, the gall bladder and ducts, and the separate oval mass (Fig. 2) lying in contact with the head of the pancreas and the gall bladder.

throughout and were not involved in the carcinomatous mass. The liver weighed together with the empty gall bladder and pancreas 1903 grams. The entire right lobe except for an area 4.5 centimeters by 5 centimeters in size at the right lower border was involved. The right lobe was a hard solid carcinomatous mass whether viewed from the superior or inferior surfaces. The left lobe presented numerous similar but discrete (Fig. 1) nodules on all surfaces and on the free borders varying in size from 1 millimeter to 2.5 centimeters in diameter. The largest of the nodules was on the posterior surface of the right lobe and measured 5.5 centimeters by 4 centimeters. The remaining lobes showed no involvement externally but a carcinomatous area 1 centimeter in diameter was found on section of the caudate lobe. A separate oval mass 5 by 4.5 by 3 centimeters (Fig. 2) could be seen lying in contact with the head of the pancreas and the gall bladder. It appeared to be a retroperitoneal carcinomatous lymph node and contained caseous material. Possibly it was an accessory lobe of the liver. Transverse section of the right lobe showed solid carcinoma to a depth of from 3 to 6 centimeters in which were to be seen widely separated circular and irregularly shaped islands of liver tissue increasing in amount as the posterior surface was approached. Not more than 10 per cent of recognizable liver tissue remained in the right lobe. The distal half of the large bowel was full of clay colored fecal material. The mucous membrane was injected in places. The rectum was negative. The left kidney weighed 10 grams. The surface markings were normal and smooth the capsule stripped easily. The papilla and pyramids were prominent. The pelvis was bile stained. There was no evidence of pyelitis. The right kidney weighed 120 grams and was otherwise the same as the left kidney. The uterus tubes and ovaries were congenitally absent. The adrenals were negative. The pancreas was normal.

Microscopical examination of sections from several parts of the liver remote from the tumor

showed the following degree from thin strands of tumor cells to full size sheets. Where the tumor cells were scattered isolated groups of cells were seen surrounded by connective tissue. The tumor consisted of groups of cells of epithelial cell in a dense connective tissue stroma. The groups were of various sizes and shapes or in irregular clusters. The cells were rather uniformly small and rounded. The nuclei were rather deeply and mitotic figures were frequently numerous. No gland or duct structure could be made out and there was no bile present. In general the tumor was separated from

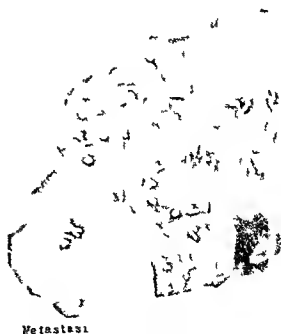


Fig. 3. Lungs showing metastasis.



Fig. 4. Photomicrograph of a section of the right lobe of the liver showing the general appearance of the tumor with the liver parenchyma. $\times 5$.

the liver parenchyma by bands of connective tissue and in such situations compressed liver cells could be seen lying in dense fibrous tissue at the margin of the growth. Elsewhere no such separation existed. Van Gieson stain and Mallory's connective tissue stain showed delicate fibers extending into the alveoli of the tumor and running between the individual tumor cells and the groups of cells. The oval masses connected with the right lobe of the



Fig. 5. Photomicrograph of a portion of the tumor showing the general appearance. $\times 4$.

liver was made up wholly of alveolar tumor surrounded by a dense fibrous capsule. The septa were dense and the masses of tumor cells larger than those already described. Mitotic figures were numerous. No liver cell or tumor cell were found in the pedicle. The spleen showed chronic fibrosis. In a few fields the sinusoids were filled or partly filled with tumor cells. There were no metastases in the retroperitoneal lymph nodes, pancreas or kidneys. The



Fig. 6. Photomicrograph of lung tissue showing metastatic new growth. $\times 75$.



Fig. 7. Photomicrograph of a portion of the tumor showing the general appearance. $\times 5$.

- 33 B CH HIR LL C h dt H dl d K I
kr kh 89 88
- 34 ID UM V h f kl Ch o 3 i q
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- 3 KUE TER Jah b f k de h V F 883 v
- 38 I I F I R S c M d 9 45
- 3 I W Z nt lzt k f k nd h 9 3
- 4 I C r Z mm n Sp P th u Th p
- 4 I R C d I t IP Lt h f k l f h 90
- 4 M TT R C d p 90 J n
- 43 M J I ath & B t I 90 i 348
- 44 M V d SAT Ref Lt h f k d h 9
- 4 M 3 l C i R f C h f k l l 9
- 43
- 46 VAG SAV d V AS LR Ref 7 t chr f k l h
- 4 V FG R T Deut ch hl 1834 v 496
- 4b O HIER Cl d hóp d e f 841 i 833
- 49 IEL ER V J h b f k d h 9 l 69
- IE ER G h dt H db d k d r kra kh
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- PLA T Ar h f k d rh 9 6 l
- PYE S I T I L et Lo d 88 i 4
- 53 K B RT W L t L d 86 7
- 4 Sc I I ER J hrb f k nd h 9 l 300
- 4 W Ch k d k nkh 8
- 4 W D R H Wedl J h b f k d h 8 9
- 5 W 9 d M n LLL V ch l l 9 9
- 68 3
- 8 W L F H C ha lt H dl l k d k kh
- 8 9 8
- 9 V A A h f p th V t t B l 9
- 43

PERINEPHRITIC ABSCESS

ALEXANDER HAMILTON PEACOCK, M.D., FACS, SEATTLE, WASHINGTON

THE chief object of this paper which is based on the study of 21 cases is to bring out a few points in the diagnosis of abscesses which form in the immediate surroundings of the kidney. The literature on perinephritic abscess has been well reviewed both by Richardson and Hunt.

Of importance is the classification. Richardson in 1915 used the term *primary* perinephritic abscess indicating that the infection had followed a metastatic hematogenous course. Hunt in 1924 used the classification of perinephritic abscesses of renal and extrarenal origin. This seems to me to clarify the pathological findings. Abscesses of renal origin would include those associated with pyelonephrosis, lithiasis, traumatism, tuberculosis, or other infections of the upper urinary tract.

PATHOLOGY AND ETIOLOGY

As a rule perinephritic abscess of extrarenal origin shows no pathology of the urinary tract. The urines are clear, smears and cultures are negative, and there are no renal symptoms. The etiology of these abscesses has been debated at various times. Miller made a very careful anatomical study showing the relation of the perirenal lymphatics to the retroperitoneal lymphatics. Some authorities are of the opinion that most perinephritic abscesses are cortical or subcapsular and arise from the periphery of the kidney. Brunsch strongly supports this view. Lott states that in his opinion perinephritic abscess resulting from direct extension independent of renal disease is rare.

In many of the reports of cases furunculosis seems to play some part in the causation of these abscesses. Peterson reports that in one of his cases the same organism was found in the boil on the forehead and in the perinephritic abscess. In several of my series also there was a preceding furunculosis, the incubation period running from 2 to 6 weeks. Postpartum infections have been followed in a number of cases by perinephritic abscess, probably due

to extension to the perirenal lymphatics. The incidence in so many cases of all renal findings and symptom would seem to indicate that the abscess must be hematogenous born. The smears or cultures made from the pus obtained from the abscesses show the overwhelming presence of staphylococcus aureus which appeared in 15 of the 19 cases examined.

The chief aim of the abscesses of renal origin is to understand as they are in the relation to the cortex and the capsule. The abscesses with the renal capsule. In the abscesses usually have a definite infection of the urinary tract which can be demonstrated. The abscesses as a rule develop in the cortex of the kidney, become extrarenal and infiltrate the psoas muscle and the point of least resistance is found and over the anterior surface of the muscle and are therefore not in the retroperitoneum. Sometimes done under laparotomy as in one of this series.

At the site of the anterior surface are extremely rare and occurred in none of this series. Two of them formed at the upper pole of the kidney, extended upward, perforated the diaphragm and formed secondary lung abscesses. If the abscess is well visualized and its anatomical position remembered it will aid somewhat in its diagnosis. This mass forming between the kidney, the renal pelvis and the psoas muscle pushes the kidney, pelvis and ureter anteriorly and sometimes laterally. If this can be demonstrated by pyelograms and uretograms it will give positive information of the presence of the retroperitoneal and retrorenal mass.

AGE INCIDENCE

Age varied from 8 to 63 years, the average being 32.5 years. This group counted includes abscesses of both renal and extrarenal origin. The average obtained by Richardson for primary abscess was 29 years.

PERINEPHRITIC ABSCESS

ALEXANDER HAMILTON MACOCK, M.D., FACS, SEATTLE, WASHINGTON

THE chief object of this paper which is based on the study of 11 cases is to bring out a few points in the diagnosis of abscesses which form in the immediate surroundings of the kidney. The literature on perinephritic abscess has been well reviewed both by Richardson and Hunt.

Of importance is the classification. Richardson in 1913 used the term *primary* perinephritic abscess indicating that the infection had followed a metastatic hematogenous course. Hunt in 1924 used the classification of perinephritic abscesses of renal and extrarenal origin. This seems to me to clarify the pathological findings. Abscesses of renal origin would include those associated with pyelonephrosis, lithiasis, traumatism, tuberculosis, or other infections of the upper urinary tract.

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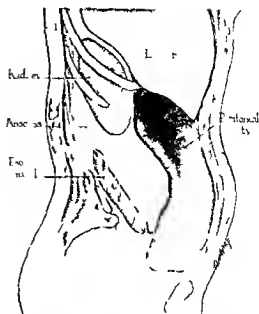
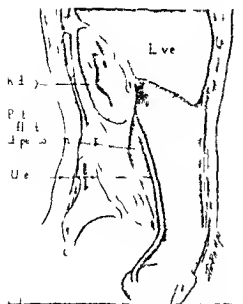
to extension to the perirenal lymphatics. The absence in so many cases of all renal findings and symptoms would seem to indicate that the abscess cannot be hematogenous born. The smears or cultures made from the pus obtained from the abscesses show the overwhelming presence of *Staphylococcus aureus* which appeared in 10 of the 19 cases examined.

The etiology of the abscesses of renal origin is much harder to comprehend as they are in direct relation to the cortex and the capsule, but both with the renal capsule. In this case we usually have a definite infection of the urinary tract which can be demonstrated by the culture as a rule. Development of the abscess of the kidney becomes more difficult to irritate the psoas muscle and retroperitoneum at the point of least resistance, and the abscess extends forward and over the anterior surface of the muscle and are therefore more difficult to detect, sometimes done under fluoroscopic examination as in one of this series.

At the cost of the interior surface are extremely rare and occurred in none of this series. Two of them formed at the upper pole of the kidney, extended upward, perforated the diaphragm and formed secondary lung abscess. If the abscess is well visualized and its anatomical position remembered, it will aid somewhat in its diagnosis. This mass forming between the kidney, the renal niche, and the psoas muscle pushes the kidney, pelvis and ureter anteriorly and sometimes laterally. If this can be demonstrated by pyelograms and uretograms, it will give positive information of the presence of the retroperitoneal and retrorenal mass.

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l t t th kh th kd y d l
ll tt th t m d t p to lly Th
l t f f th p t m

l g Se to ho n p n l b c h h k
d d t the p nt t g th p a mu les d
m s l f th l b æ Alo th m h h th
p t m lft d p d

SEX

Twelve were males 9 females—a more even distribution than counted by Richardson who gave a total of 16 males and 4 females. This high rate in males may be due to the increased frequency with which cutaneous infection due to trauma occurs in males.

SYMPTOMS

Fever was observed in all of the patients. The graphic chart pointed to a daily elevation of 102 degrees to 104 degrees F. followed by a sharp decline with an accompanying sweat. Chills were noted in most of them. The fever was usually mild in character. This fever leaves the patient exhausted and progressive weakness develops.

Nausea was recorded in 15 cases and vomiting in 11. The symptoms are due to intoxication and absorption from the abscess. In some cases the symptoms were extremely severe and added greatly to the exhaustion of the patient but they promptly disappeared after incision of the abscess as did the fever and chill.

The duration of the symptoms in the extrarenal type was 9 days to 6 weeks. A number

of these seemed to be preceded by furunculosis or skin infection. In the renal type of perinephritic abscess the duration was much longer even to 5 years. Most renal infections develop slowly and extend beyond the kidney only after considerable drainage has been done. For example Case 21 gives a history of large recurring calculi of the right ureter obstruction of the ureter and urinary infection for a period of 3 years.

Pain as a rule is severe. It is usually a unilateral backache at a level of the third to the fourth lumbar vertebrae and in the costo-vertebral angle. It was present in all of these cases. Fourteen cases had right sided abscesses and 7 left ones. There were no bilateral cases. The pain was described as throbbing, almost constant fixed and increased by walking or any movement of the vertebra. This was noted in 18 cases. Six patients complained of a radiating pain or colic most of which was downward into the groin or thigh.

In conjunction with pain should be mentioned irritation of the psoas and erector spinae muscles which produces spasm rigidity and partial fixation of these muscles. The presence of an abscess in the renal niche

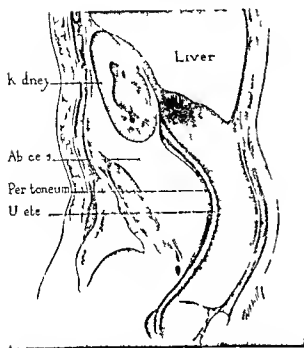


Fig. 3 Illustration of the elevation of the ureter which is displaced anteriorly by a large perirenal abscess. This change in the normal plane of the ureter makes possible the diagnosis of perirenal abscess and retroperitoneal tumor by the use of stereo ureterograms.

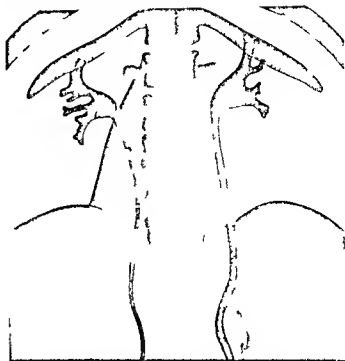


Fig. 4 Sketch of pyelogram which shows no displacement of the ureters in the anteroposterior position. This shows the mild curvature of the spine which was noted in 10 of 18 of the cases studied. It illustrates the blurring of the line of the psoas and the transverse processes of the vertebrae on the affected side. Stereopyelograms show the right ureter displaced markedly forward.

explains the rigidity of the spine and at times a temporary lordosis. It is also the cause of spasm of the psoas with relief obtained by flexion of the thigh.

Tumefaction was observed in 17 cases. At times it was very slight and was discovered only on careful inspection with the patient lying perfectly straight on a hard flat bed. In this position also can be demonstrated lateral curvature of the spine due to pressure of the abscess. This will be further explained in the roentgenograms. To reach objects on the floor these patients squat instead of bending forward. Marks of external heat applications are frequently seen over the costovertebral angle.

Leucocytosis was invariably present and was much higher than the count common to the degree of fever present. The lowest count was 11,800 in Case 15, a male of 63 years with poor resistance, and the highest 39,000 in Case 7, a young woman of 29 years with an acute staphylococcus infection of the urinary tract. The average leucocyte count was 593. A unilateral backache fever and unusually high leucocyte count should bring perinephritic abscess into consideration.

Urological symptoms in extrarenal perinephritic abscess were absent or slight. The commonest symptom was a painless frequent urination noted in 13 cases; this is probably reflex. Pyuria covers all cases reporting any infection in the urine, even though there may be very few bacteria, as in some of these 11 cases. Microscopic examination showed the following bacteria:

| | |
|----------------|----|
| Bacillus coli | 7 |
| Staphylococcus | 3 |
| Streptococci | 1 |
| Sterile | 10 |

Urinary infection probably plays a small role in these abscesses and could be a secondary rather than a primary infection of the urinary tract.

Hæmaturia was given as a symptom in 5 cases. One of these, Case 21, suffered from an impacted calculus of the ureter. The 4 other cases (Cases 14, 17, 15, and 8) had marked bacillus coli infection of the upper urinary tract. Hæmaturia is not infrequent in this type of infection.

DIAGNOSIS

At times febrile signs are more difficult to distinguish than perinephritic abscesses. Their deeply situated position, the perfect protection of the renal fossa and the lack of urinary symptoms and hindrance increase the mystery of the pain they can cause.

Schuck and others have placed importance in the differential leucocyte count in the segmental urine from each kidney and the bladder. Pyuria with negative findings in ordinary culture media is suggestive of tuberculosis. A trace of albumin, occasional tube casts, white blood cells and tryplococci were found among the urine of cases. Observers in general seem to agree that in most of these cases the urinary findings give no helpful information. The abscess is outside of the kidney and does not produce change in the upper urinary tract.

In writing on perinephritic abscess in children, Palmer states that this disease is usually mistaken for tuberculosis of the hips or spine. The child ceases active play, limps for a while, the thigh is slightly flexed and the body bent forward. An indefinite pain starts in the back, later localizing in the costovertebral angle. The location of the abscess influences certain movements of the pine, producing either hyperextension or constant flexion. Hip joint flexion is excluded by the painless rotation of the thigh in the flexed position. In disease of the pine, all pineal muscles are in reflex spasm, pain is observed by movements in all directions. In perirenal abscess the pelvis and lower trunk can be moved in all directions. To illustrate the difficulty of diagnosis, the following case is reported in this series as related.

At 11 months of age, with previous good health, the child fell on its left hip and limped markedly. The father, who had been a soldier, was called to the attention of the child's condition. The child was taken to the hospital by the parents. A normal blood count, normal urinalysis, and normal chest x-ray were obtained. The child was treated with penicillin and sulfa drugs, but the limp persisted. A second x-ray of the hip was obtained, showing a soft tissue mass. The child was then operated on, and a perinephritic abscess was found. The abscess was drained, and the child recovered completely.

ney was found with no evidence of perirenal inflammation. However, manual palpation of the erector spinae muscles elicited fluctuation. The first wound was closed and a second small incision was made into the thick muscle of the spine, thus revealing a suppurative mass. The result of all of the careful symptomatology of a perinephritic abscess were typical.

In summing up, Richardson says: Cystoscopy, ureteral catheterization, and x-ray, although essential in excluding disease of the urinary tract or spine, may be of no positive help in these cases. The three principal points in diagnosis are continued fever, leucocytosis, and abdominal or costovertebral tenderness. Since that time other roentgenological observations have been made. In 1912 Dr. Bela Alexander of Leipzig in his book *The Examination of Kidneys and Urinary Tract* mentioned two cases of perinephritic abscess in which he found the disappearance of the line of the psoas muscle, the obcuring of the transverse processes, and a poorly defined kidney outline as being important findings in the diagnosis of perirenal abscess. In one case a further observation was made: a lateral curvature of the spine and retraction of the thigh.

In May, 1915, Dr. Vidor Revesz of Budapest read a paper before the Hungarian Urological Society and a week later demonstrated 3 cases amplifying and illustrating the points brought out by Alexander.

On April 8, 1928, Lipsett and Edwin Beer, both of New York, independently and simultaneously published articles covering the points in diagnosis. The clouding of the line of the psoas muscle often helps in diagnosis, but is not infallible. All too frequently flatus obscures the renal outline and the edge of the psoas. Of more importance and greater consistency is the lateral curvature of the spine.

The vertebral line arches slightly around the abscess. Eighteen cases of this series had a renal study and this arching was noted in 10 of them. A natural curvature and faulty position on the table must be guarded against.

The author wishes to call attention to the great value of stereoscopic roentgenograms. Several perirenal abscesses have been easily diagnosed in this way which were negative with the flat film. With the patient in the

prone position an extrarenal mass always pushes the kidney and ureter, anteriorly and sometimes laterally. This is beautifully shown in a stereoscopic picture. The normal kidney lies in its usual plane while the other is displaced forward and the ureter curves like a taut bow. A lateral roentgenogram would show the same thing but offers too many difficulties. The exposure must be a short one (1 to 3 seconds) with 100 milliamperes of current.

To refer back to the paragraph on the pathology of perinephric abscess it is easy to understand why a stereoscopic picture will give the true anatomical relations of the retroperitoneal organs and structures. On account of the obscure symptoms early in the formation of these abscesses they are a long time developing and hence of considerable proportion when presented to the urologist for study. There is a sufficient mass in most cases to produce a real displacement.

SUMMARY

The chief points in the diagnosis of perinephric abscess are

- 1 Constant fever
- 2 Severe pain localized in the costovertebral angle
- 3 High leucocytosis
- 4 Curvature and rigidity of the spine
- 5 Stereoscopic roentgenogram showing the displacement of the kidney and ureter anteriorly or laterally due to a retrorenal or retroperitoneal mass

SUMMARY OF CASES

CASE 1 9396 W E M male aged 50 years laborer. Six months ago this patient had an appendiceal abscess drained. He had been ill for the past 3 weeks with fever and constant pain in the upper right abdomen and back. Examination showed a leucocytosis of 13,000. The urine contained many colon bacilli and there was localized tenderness and moderate tumefaction in the right costovertebral angle. Renal study demonstrated negative urines. The pyelogram showed rotation of the kidney away from the median line. There was moderate curvature of the vertebrae. Incision of the right kidney angle revealed the pus of a large perinephric abscess.

CASE 2 755 A L female aged 28 years housewife. This patient's illness apparently started after her last confinement 3 months previously. She

complained of fever, chills and moderate pain in the upper right abdomen and back. Two months before an appendectomy and cholecystectomy were performed for right abdominal pain. These operations did not relieve her and the pains became steadily worse. At the time of her examination she seemed extremely ill. Examination showed a young woman who had undergone considerable loss in weight. Temperature was 102 degrees. In the upper right quadrant of the abdomen was a large mass which produced spasm and rigidity of the right rectus muscle. An incision effected drainage of a considerable amount of foul greenish pus.

CASE 3 9505 Mrs S W female aged 23 years housewife. This patient had had no recent illness. She stated that for the past 10 days she had been ill with fever, chills and loss of strength and that she was constantly getting worse. On examination she had the appearance of being very ill. Her temperature was 102 degrees, respiration 28 and a labored pulse 110. Over the left costovertebral angle were noted tumefaction, marked muscle spasm, tenderness and scars of heat. Leucocytosis was 16,610. Urinalysis was negative. The roentgenograms demonstrated an arching of the vertebrae with a clouded area below the left kidney. An incision was made over this area and a large abscess was drained.

CASE 4 9155 W J male aged 42 years telephone worker. For the past 2 months this patient had noted that his urine was cloudy. Ten days before the examination he was taken with right sided abdominal colic which radiated to the testes. A second attack occurred the day before the examination. The temperature was 100 degrees, leucocytosis 18,000. There was muscle spasm in the upper right abdomen and back. Renal study demonstrated cloudy urine which was loaded with staphylococci. Catheterization of the right ureter demonstrated an occluded ureter 3 centimeters below the renal pelvis due to an impacted calculus. There were two large calculi in the calyces. The kidney was exposed and a subcortical abscess was noted. The calculus was removed from the ureter and because of the multiple kidney abscesses it was deemed advisable to do a nephrectomy. The perinephric abscess was clearly due to a staphylococcus infection which in all probability was the etiology of the calculi and the multiple kidney abscesses. The patient made a good recovery and the staphylococci disappeared after neosalvarsan injections which seem to be a specific for this bacteria in the urinary tract.

CASE 5 14140 W D male aged 63 years transfer owner. The patient stated that 2 months before he developed a boil in the ischioanal space. This came to a head and he treated it himself. It persisted but gradually healed. Four weeks after the appearance of the boil he complained of pain and swelling in the upper right abdomen. Fever and chills set in and he has been ill more or less since then. The pain was a throbbing one and was present most of the time.

TABLE I—INCIDENCE

| Age | C | A | C |
|-----|---|----|---|
| 8 | | 3 | |
| 8 | | 3 | |
| | | 33 | |
| 3 | | 33 | |
| | | 4 | |
| | | 33 | |
| 8 | | | |
| | | 53 | |
| 3 | | 63 | |

I v t n i t h b l m n h e d a l a r g e m a
t l g t m t h o t e t e b r a l g l e t o t h e a n
t u j r f f t h i l u m I t a s h d a n d
h l k t k h y p e r n t h r o m a T h e e v e r n o
u r l k l m p t m f k i n d t h e u r e w a s c l e r
l t k t i n l l x n i n t o n T h e l e u c o e y t o s i s
N A a l t l a s m a l e a n d t h e u r e t e r s
l r l t l c a t a t a i g h t l i e t h e p l e
l l n t u l r m l T h t e r e o p v e l o
k l l n t d t h i g h t u r e t e r a l
k l l c l f l b a r e t o p e t a l m a
l h m k l A l a g s o f p e r i n e p h r i t e
l a l l a l e a n c i e l a n d a
l r k t l g h p u a a c u t e l T h
l l i l t u t l t a p h y l o r e e n
l c e 4 M S f e m l e g e d o v e a r s
h f J a l l h t e n u n a b l e t
l k l k l h l e a l h n e a n t e l l g e n t h t r y
l l f l e I t l e f h e v r t h a t h
h l l i l f r k i t h c o n t a t p a i n t h e
l l l t l l m t h a t t h p a i n r a d i a t e d i n t o
t h g l t t h i g h l t h a t h e h a d h d f e v r a n d
l i l l l t n l e l n a n t h e r i g h t
t t l l p l l t e m a t u e a s o d e
k l l t t 8 o o N n l t u l v a
l l l m a p t d i t h n e d l e a d
l l l d h h l b i l l u c o l o n c u l
t r A i n t h n m l n l l g e a b c e s

C S S k N l g e d o v e
h l t h T h t u t h l b e l l f r e r a l
t l t h g l t l l h h a n c r e i g g
t t t S h l m p l a i n e l f f e r c h i l l
t l n t k T h e l t t s e t e m e l
l h e i t b u a b l e t e a t a t h i g
l k l t j j e n t l n m a l p o n d i t
l l u t t h t m d i l n o t i m p r o v e
l t t t t t h i t n t h o e l h e r t o b e e r y
l l h k s m t n d c l m m y F e v e r a r i e d
t m o o l g r t d g e e l e u c y t o i a s
5 0 0 0 A l l f o o d m e d T h p t i e n t l a y o n
h r l t t l t h t h g h t t h g h d r n u p T h
l l m h l c t l l t l r e s t h l i g h t
t u t n t t h u j r l g h t q u a l n t
A r l t d l h i c h s h o e d s t p h y l
o c u f t n f b t h k l e u r i n e R n g e n o
g m l m n t r t e i m o d r t e c r t u r e o f t h e v e
t l r e l l o g a m t m a d e A d g n o
a a l f p r n e l a b h i c h f o u n d t
p e r a t i o T h a b s c e c p i d t h l o e r p o l e o f

TABLE II—SYMPTOMS

| Cas | C |
|-------------------|---------------|
| Ch II | P n m l p m |
| F | I a t o f p e |
| S e x t | T m f t o 4 |
| N | I q e c y f u |
| V o m i t g | t 3 |
| P t h b b g f e d | 18 P y u |
| I f d | 6 H e m t 5 |
| P c l e l | 6 |
| P b k a h u | |
| l a t f | |

t h e k i n y a n d w a s t h s i z e o f a g o l f b a l l O n c u l
t u r e t h e p u s h o e d s t a p h y l o c o c i s i m i l a r t o t h e
o g a n i s f o u n d i n t h e u r i n e

CASE 8 1799 V S f e m a l e a g e d 18 v e r
h o u e i f e T h p a t i e n t a s n e v e r r o b u t b u t h a d
b e e n r e c n a b l y w e l l u p t o h e r p r e s e n t i l l n e s S h e
a s n o 4 m o n t h s p r e g n a n t O n e m o n t h b e f o r e s h e
h a d d e v e l o p e d c h i l l f e v e r a n d s w e a t s T h e f e v e r
a s h i g h a n d i r r e g u l a r T h e r e w a s p a i n w i t h s o m e
b u l g i n g i n t h e r i g h t k i d n e y a n g l e I x a m i n a t i o n
h a d s a l l a n a e m i c s k i n T e m p e r a t u r e v a s
104 d e g r e e A b d o m e n v a s m o d e r a t e l y t y m p a n i t i c
a n d s h a d t h e p r e s e n c e o f a 4 m o n t h s p r e g n a n c y
T h e r e v a s a n a r e a o f i n c e a d d u l l n e s o v e r t h e
i l t a c e r e s t I c u c o e y t e c o u n t w a s 15 5 0 0 e r y t h
c y t e s 2 7 0 0 0 0 h a e m o g l o b i n 35 p e r c e n t C t h e
t e r a t i z a t i o n o f t h e u r e t e r s s h o e d t h e p r e s e n c e o f a
f e p u s e l l s a n d n u m e o u s g r a m n e g a t i v e b a c i l l s
c l i n b o t h k i d n e y s P e l o g r a m s s h o e d d i l a t e d
u r e t e r s a n d k i d n e y s o n b o t h s i d e s i n d i c a t i n g a m l d
d e g r e e o f h y d r o n e p h r o s i s o f p r e g n a n c y T h i p a t i e n t
a s o p e r a t e d u p o n f o r p e r n e p h r i t i c a b c e s v i e h
d r a i n e d f o r e v e r a l w e e k s S h e u l t i m a t e l y m a d e a
c o m p l e t e r e c o v e r y

CASE 9 3155 E R m a l e a g e d 29 y e a r s
c l e r k T h e p a t i e n t h a d n o m e d i c a l h i s t r y e x c e p t
s h o p n e l v o u d s s u s t a i n e d i n t h e W o r l d W a r F o r
t h e p a s t 3 w e e k s h e h a d b e e n s u f f e r i n g w i t h f e v e r
c h i l l a n d p a i n t h e u p p e r r i g h t a b d o m e n T h e e
r e n o u l o g c a l s y m p t o m s T h i s p a t i e n t g a v e t h e
a p p e a r a n c e o f b e i n g i l l T h e s k i n v a m o i s t a d
s a l t t e m p e r a t u r e v a s 10 d e g r e e s l e u c o c y t o s i s
v a s 14 5 0 0 I n t h e u p p e r r i g h t q u a d r a n t o f t h e
a b d o m e n t e n l i g p o s t e r i o r l y a c r u m c r i b e d a r e a
o f t e n d e r n a s a n o t e d U n a l s e s e r e n e g a t i v e
A r i g h t p e l g r a m s h o e d o l a t e r a l d i s p l a c e m e n t
o f t h e u r e t e r T h e d i a g n o s i s w a s p e r n e p h r i t i c a b c e s
T h e a b c e s v a s f o u n d o n t h e l e p o l e o f t h e
n t e r s u f a c e o f t h e r i g h t k i d n y T h e r e w a s
c o s i d e r a b l e i n f l a m m a t o r y t i s u e

CASE 10 3650 T T m a l e a g e d 25 y e a r s
J a p a n e s e e m p l o y e d i n a g g e T h i p a t i e n t g a v e
a h i s t o r y o f b o i l s o f t h e r i g h t t h i g h t m o n t h b e f o r e
h p r e s e n t a l l e s F o r t h e p a s t 3 w e e k s h e h a d
b e e n i l l w i t h c h i l l f e v e r a d i p a n n i n t h e l e f t s i d e
a n d b a c k T h e p a i n d i d n o t r a d i a t e T h e r e w a s n o
h a e m a t u r a n o f e q u e c y n o b u r n g H e a s u n a b l e
t o s t a n d e c t o n a c c o u n t o f h i s p a i n T h p a t i e n t
s t o o p e d m o d e r a t e l y a n d a l k e d w i t h a l i m p
d u e t o a f l e x i o n o f t h e l e f t t h i g h t I l p l a t i o n o f t h e

TABLE III—URINALYSIS

| | C |
|---------------|----|
| Staphylococci | 3 |
| Bacillus coli | 7 |
| Streptococci | 1 |
| Sterile | 10 |

abdomen demonstrated a fluctuating bulging mass extending over the crest of the ilium. The urine was clear leucocytosis was 16 000. The left pyelogram showed the kidney pushed some distance away from the lateral margin of the vertebrae. Perinephritic abscess was diagnosed and incision released a large amount of pus and broken down tissue. The abscess cavity was quite large and dissected downward following the psoas muscle.

CASE 11 12682 A W M male aged 48 years carpenter. The medical history was indefinite but he stated that he had not felt well for 5 years. Pain had gradually developed in the right inguinal fold. This pain was constantly getting more severe. Later he had suffered with frequent urination diurnal and nocturnal his appetite was poor and he was fast losing in weight and strength. Examination showed the patient markedly emaciated and with sallow skin. The right thigh was stiff and its motion limited. The teeth were very poor. A great many of them were decayed or broken off. Posteriorly a slight tumefaction was noted. In the urethra there was a stricture of the prostatic portion. His leucocytosis was 25 000. His blood chemistry showed some retention of creatinin and urea nitrogen. Catheterization of the ureters showed the presence of a staphylococcus infection. This patient was seen in his home and was in such condition that removal was contra indicated. The condition was so clear that an incision under local anaesthesia was made and a large perinephritic abscess was drained.

CASE 12 13461 G M male aged 2 years delivery man. This patient gave no history of infection. He said that his present trouble had begun 6 weeks before and was ushered in with chills and fever and pain in the right side and back which was increasing in intensity and interfered with his getting around. He was now suffering with severe pain insomnia and marked reduction in weight. His temperature was 103.6 degrees. Leucocytosis 12 000. The teeth were badly decayed. The right side of the abdomen was mottled from the use of local heat. The area over the right costovertebral angle was rigid and showed some tumefaction. An area of dullness extended partly around to the lateral edge of the abdomen. A renal study was made and all findings were negative except a large indefinite right kidney outline. The urines were clear. A diagnosis of perinephritic abscess was made. Fourteen ounces of heavy thick pus was evacuated.

CASE 13 13510 J W B male aged 38 years printer. There were no infections in this patient's history. Three weeks before the examination this man was taken with a sharp pain of stabbing char-

TABLE IV—CULTURE FROM ABSCESS

| | Cas |
|------------------|-----|
| Staphylococci | 15 |
| Bacillus coli | 2 |
| Streptococci | 1 |
| Actinomycetaceae | 1 |
| Not ascertained | 2 |

acter. It came on about 3 p.m. reached its maximum intensity about 5 p.m. and required morphine to relieve it. It was impossible for this patient to lie on his right side. Examination showed a temperature of 103.6 degrees. The right abdomen was marked from heat applications. There was no superficial rigidity but there was pain on deep pressure over the right costovertebral angle.

There was moderate rigidity of the spine on stooping. Renal study showed slight albuminuria. The right kidney was of normal size and in normal position and was not rotated. Leucocyte count was 33 000. A diagnosis of perinephritic abscess was made from the symptoms of fever localized pain rigidity of the spine and high leucocyte count. At operation a cupful of thick creamy pus was found.

CASE 14 11625 Mrs E R R female aged 32 years housewife. This patient gave a history of left renal colic for the past 4 months accompanied by a severe cystitis for 2 weeks. The attack ceased until 3 days before the examination when she had severe left sided pain. There were also chills and fever. She further complained of burning urination, pyuria, hematuria, nausea and vomiting. She had not eaten for 3 days. Examination of this patient showed a well nourished young woman who was 3 months pregnant. There was extreme tenderness over the entire left abdomen and back with flexion of the left thigh. Leucocyte count was 18 400. Haemoglobin 58 per cent. Urine was very turbid gave a trace of albumin and showed many pus cells and bacillus coli. A renal study was made and demonstrated an obstruction of the left ureter 15 centimeters from the bladder. This obstruction was passed with a No. 5 catheter. The left kidney urine was cloudy scant in amount and contained many pus cells and bacillus coli. The right kidney urine was negative. The left renal pelvis held 20 cubic centimeters of solution without pain. Pelvic lavages were performed without improvement. Following the last one she miscarried. Her condition improved for a while but months later it reoccurred as bad as ever. Due to the poor functioning and continual infection of the left kidney surgical measures were advised. A large left kidney was found and a perinephritic abscess measuring 3 by 5 centimeters was located at the lower pole. This was apparently subcapsular in origin. Due to the marked pyonephrosis present a nephrectomy seemed to be indicated. This perinephritic abscess was apparently renal in origin.

CASE 15 12780 R B T male aged 33 years woolen salesman. This patient gave a history of bacillus coli infection of the urinary tract existing

for 10 years. He was now suffering with pyelitis and colitis accompanied by hyperpyrexia, nausea and vomiting. The patient had had numerous pelvic lavages. In one of these apparently due to irritation from the contrast solution or the use of sodium hydroxide instead of sodium iodide solution severe symptoms followed. The left ureter became oedematous, closed up entirely and could not be catheterized. In due time the same process occurred in the right ureter. No function was observed from the left side. When he entered the hospital the patient had not voided for 36 hours and the bladder was empty. There was a large bulging mass extending from the right costovertebral angle to the lower right abdomen and pushing over Poupart's ligament. The patient was extremely ill and in a condition of collapse. His leucocyte count was 18,000. Under local anaesthesia a huge perinephritic abscess was opened and drainage was instituted. Subsequently all of the kidney drainage took place through this sinus and at no time was there any urine in the bladder. This patient survived one year. The right kidney secreted through the operative sinus. No urine during this time appeared within the bladder and both ureters were permanently occluded.

CASE 6 8037 Mrs A S female aged 30 years housewife. The patient stated that following a miscarriage 1 year ago she had felt poorly and there had been some dull pain in the region of the left kidney. One month before the examination this pain became acute and since that time had steadily increased in severity. Lately she had developed a fever. There were no urinary symptoms. Examination showed a woman who had lost considerable weight. Respiration was 30, temperature 103 degrees, leucocytosis 17,000. The abdomen was relaxed and showed no tumefaction. Percussion showed a mass in the region of the left kidney with a slight bulging posteriorly. The renal study was entirely negative except for a slight trace of albumin. A large perinephritic abscess was incised and drained.

CASE 17 1033 W O male aged 8 years manufacturer. This patient's medical history was negative except for repeated attacks of tonsillitis. The first pain on the left kidney came on 6 weeks before the examination. For the past 4 weeks it had been getting steadily worse and he had been confined to bed. He reported some haematuria frequently and burning urination. His appetite was very poor and he had lost 20 pounds in weight. Examination showed a slender young adult. The most prominent symptom was his expression of pain and distress. There was marked rigidity of the spine and tenderness on the left costovertebral angle. In moving around he had a very marked stoop and flexion of the left thigh. Temperature 103 degrees, leucocytosis 33,600. A renal study was made and showed normal urinalyses. Pyelograms demonstrated a bulging of the left ureter forward and away from the lateral line. There was also a slight curvature of the vertebrae. The diag-

nosis of perinephritic abscess was confirmed by incision. The culture showed staphylococcus.

CASE 18 0140 Mrs H C female aged 26 years waitress. Her medical history was negative. Three months previously she developed a cramp-like pain in the left kidney region which persisted day and night. Two weeks before the examination she had noticed a little blood in the urine. Since then there had been periods of frequent urination. Examination showed a young woman apparently in severe pain. She had lost 15 pounds in weight. Palpation of the left costovertebral angle demonstrated fixation and spasm of the muscles, extreme pain and an area of dullness. Her temperature was 103 degrees, leucocytosis 15,600. The urine contained many pus cells and bacillus coli. This patient was relieved on incision of a left perinephritic abscess.

CASE 19 0443 W E male aged 53 years carpenter. The patient stated that 3 weeks previously he had had a carbuncle at the back of the neck. It had been lanced and was still draining. Shortly after this pain developed in the region of the left kidney. The pain was increasing in severity. He had had fever for 2 weeks but no chills. Examination showed a middle aged man with flexion of the left thigh. Temperature was 102 degrees, leucocytosis 18,000. The back showed a tender tumefaction in the left costovertebral angle accompanied by muscle spasm. A renal study was made and the findings were entirely negative. Founded on the symptoms of fever, leucocytosis and localized pain a diagnosis of perinephritic abscess was made. A large abscess of staphylococcus infection was drained.

CASE 20 10319 R S male aged 8 years school boy. The patient had been treated surgically for a suppurative appendix 2 years before the examination. For the past 6 months he had been suffering with fever, sweats and pain over the right kidney. He lost a great deal of weight and had no appetite. His father stated that he had been poorly and was withdrawn from the milk of a single cow. It was later found that this cow had lump jaw and the cow was killed. The child was greatly emaciated. The right leg was markedly flexed. Examination of the back showed a swelling and a painful tumor on the right kidney angle extending forward. Haemoglobin was 40 per cent, erythrocytes 4,400,000, leucocytes 4,000. Temperature was 104 degrees. A renal study was made. The left kidney was catheterized and found to be negative. The right ureter was obstructed near the bladder and no function was observed. Roentgenograms showed a large mass in the region of the right kidney. Surgery was recommended as the only source of relief and a right nephrectomy was advised. A large perinephritic abscess was first met. The kidney showed the presence of a chronic inflammatory condition resembling the gross appearance of renal tuberculosis. The patient survived the operation about a week but steadily lost his strength in spite of blood

transfusion and intravenous therapy. Postmortem findings showed a wound in the right lumbar region with some discharge issuing from it. The upper abdominal cavity was opened and a gush of creamy pus was seen. The general peritoneal cavity was normal. There were no adhesions or peritonitis. The intestines were examined throughout. The duodenum showed a perforated ulcer large and yellow into the right renal fossa. A second perforation was found between the ascending colon and the wound. This was apparently postoperative. The liver was hypertrophied and showed 3 large abscesses: one on the extreme left lobe, one large one in the upper right lobe, and a third one in the inferior portion of the right lobe near the gall bladder connecting the duodenum and the right kidney. The left kidney was hypertrophic with smooth and perfectly normal tissue except for a small spot in the lower pole. Pathological diagnosis: actinomycosis.

CASE 21 10223 Mrs. R. N. female, aged 37 years, housewife. This patient presented a history of long standing urinary infection and calculi of the right ureter. Two large calculi were removed from the lower third of the right ureter by transperitoneal exposure. The urinary infection persisted with periodic attacks of chills, fever, and sweats. Eighteen months before a ureterolithotomy had been performed to remove a calculus 4 centimeters in length. A good recovery was made and patient experienced relief for a year. Then pain developed in the upper abdomen and back. There was a moderate fever. The patient phoned one day that she had been taken with pulmonary hemorrhage and she was sent immediately to the hospital for a study. Her temperature was 104 degrees, leucocyte count was 18,000, respiration 32. There was a moderate dyspnea and embarrassed respiration. Suspecting a pyelitis due to the history of urinary infection,

catheterization of the ureters was done and the urines were found to be clear and normal. While the patient was still in the hospital she developed a cough and had a foul smelling expectoration. Percussion disclosed considerable increased dullness around the liver. Roentgenograms showed a marked elevation of the diaphragm on the right side. An exploration was made of this dull area and a huge subdiaphragmatic abscess was drained. This showed staphylococci, the same bacteria as was found in the urine. Following the patient's history, symptoms and findings there was apparently a perinephritic abscess which broke through the diaphragm and produced a secondary lung abscess. It is now 20 months since this abscess was drained. The patient has no symptoms and recovery is perfect.

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OVARIAN IRRADIATION AND THE HEALTH OF THE SUBSEQUENT CHILD

A REVIEW OF MORE THAN TWO HUNDRED PREVIOUSLY UNREPORTED PREGNANCIES IN
WOMEN SUBJECTED TO PELVIC IRRADIATION

DOUGLAS P. MURPHY, M.D., F.A.C.S., PHILADELPHIA, PENNSYLVANIA
City H. H. 1 G. 1 g. R. h. h. C. y. (P. y) b. z.

THE present paper is the second communication dealing with the health of children born following maternal pelvic radium or roentgen irradiation. In the first publication (11) the literature was reviewed which dealt with the health of all children reported as born following maternal pelvic irradiation. In the present study the health of another group of children born of irradiated mothers has been analyzed. These two publications when combined will represent the largest collection of reported cases available for study dealing with the possible relationship that may exist between maternal pelvic irradiation and the health of subsequent children.

The *unhealthy or defective* children born of previously irradiated mothers form the chief subject of this investigation. An attempt has been made to determine the nature, seriousness, and frequency of any disturbances of health or defects in development among these children and to ascertain if possible whether the maternal irradiation was entirely or only partly responsible for such faulty structure or disturbances of function as may be found among them.

By far the larger part of the material forming the basis for this investigation was secured in response to a questionnaire sent to leading gynecologists and radiologists throughout the United States. To these records have been added several reports of pregnancies which have appeared in the current literature since it was recently reviewed. A number of pregnancies previously reported by one author (17) are also included having been unintentionally omitted from the first paper.

From the study of the literature and from an estimation based upon the replies to the questionnaires herein reported it seems apparent that relatively few children have been born to women who were subjected to pelvic irradiation.

This small number of subsequent children is probably due both to the amount of irradiation employed (the chief reason) and to the peculiarity of the local pelvic disturbance for which the irradiation was prescribed.

In spite of the small number of pregnancies that have occurred in irradiated women reports have appeared from time to time in the literature indicating that some of the children born subsequent to pelvic irradiation of the mother have presented disturbances of health or defects of development. It has been asserted further by some of the observers that in certain cases the maternal treatment has been responsible for the disturbances noted. On the other hand many of the children who have been born following maternal pelvic irradiation have appeared to be entirely normal.

The experience of individual observers has necessarily been limited and consequently the combined experience of the medical profession has not been large for these reasons but chiefly because of the conflicting opinions that exist and the lack of definite knowledge of the entire subject the present clinical and experimental study has been undertaken.

The clinical portion of this study includes a review of the literature (11) the present investigation deals with previously unreported cases and a third communication will analyze in greater detail the physical condition of the children mentioned in the first two publications with special reference to the factors concerned with the maternal treatment and the bearing of these factors upon the health of the children.

Extensive animal experiments that deal with the possible inheritance of defects as produced by ovarian irradiation applied *prior to fertilization* of the ovum are also being conducted. This part of the work was suggested by the observations of Reifferscheid Lenz.

Bagg and others who found that *preconception* ovarian irradiation might in some instances be followed by the birth of abnormal offspring and that the damage so produced might not appear until the second generation of descendants had been reached.

Each year sees a more widespread use of radium and the roentgen ray in the treatment of benign gynecological lesions in both married and single women of childbearing age. From our present studies it seems quite apparent that radiologists have been unable as yet to determine the *exact* amount of radium or roentgen irradiation that is *just* sufficient to produce sterility. Lack of knowledge upon this point makes it important to learn whether, when an attempt to produce sterility by this means fails, the subsequent pregnancy will end successfully or the child born be injured or defective as the result of the previous maternal pelvic irradiation.

When *substerilizing* irradiation treatments are indicated the patients or their families are frequently anxious to know whether the irradiation will injure in any way the health or impair the development of subsequent children. Should pregnancy follow such treatment.

Therapeutic abortion can also be induced by the roentgen ray (18). Instances have been reported from abroad in which abortion failed to take place and the pregnancy went to term.

Pregnant women suffering from carcinoma of the cervix have been irradiated and this has given rise to the question as to what effect the irradiation might have upon the health of the child should it survive the complications resulting from the maternal disease and the manipulations incident to the application of the treatment.

In still other cases pelvic irradiation has been employed in the treatment of small uterine myomata and unsuspected living embryos have survived the treatment and the pregnancies have gone to term. Pregnancies may therefore be associated with or follow various pathological conditions which require pelvic irradiation. Thus the pregnancy may take place at some time subsequent to the treatment or it may occur during the course of treatment or the condition may be entirely unsuspected when the irradiation is employed.

In the two latter cases even though large amounts of irradiation are employed the embryo may not be aborted and may survive and go to term. In view of the different circumstances with which pregnancy and pelvic irradiation may be associated it is important to know whether such treatment will in any way injure the health or impair the development of the subsequent children. It would be well also to know whether if damage results from such maternal exposures it occurs under all the circumstances cited here or only under *certain* of these circumstances.

REVIEW OF THE LITERATURE

Three hundred and twenty pregnancies reported in the literature have been analyzed (11). *Postconception* irradiation was practiced in 53 instances with 44 full term pregnancies. In the latter group there were 27 (61 per cent) defective children—that is children who presented some disturbance of health or defect in development at some time while under observation. In a group of 265 pregnancies following *preconception* irradiation of 198 full term pregnancies there were only 10 (5 per cent) children who were reported as not perfectly healthy while under observation.

In both of the aforementioned groups the percentages (61 and 5) were estimated with a disregard as to whether any other factors could possibly have been responsible for the disturbances observed. A critical examination of the various abnormalities listed in these two groups indicated at once that quite a number of the variations in health could easily be explained upon grounds other than maternal irradiation. The relationship between these defects observed and their probable causes will better be understood by referring to the reports recorded in our first publication.

Even when all the disturbances of child health apparently not due to maternal irradiation are omitted from consideration *postconception* irradiation therapy still appears to be a much more dangerous procedure in so far as the health of the child is concerned than is *preconception* irradiation.

The difference between the effects of the irradiation as it was administered before or after conception, was further emphasized in

TABLE I—INDICATIONS FOR PELVIC RADIUM AND ROENTGEN TREATMENTS IN ONE HUNDRED THIRTY ONE INSTANCES IN WHICH PREGNANCY WAS CO-EXISTENT WITH OR FOLLOWED THE TREATMENT

| Indication | Number of Cases |
|------------------------|-----------------|
| Leukemia | 8 |
| Myeloma | 25 |
| Epilepsy | 5 |
| Bleeding from uterus | |
| Infertility | |
| Endometriosis | 2 |
| Polytoma | |
| Oligomenorrhea | |
| Pulmonary tuberculosis | 2 |
| Nephritis | |
| Leukemia | 1 |
| Syphilis | 1 |
| Tuberculosis | 31 |
| Total | |
| 100 cases | |

is not prejudicial to the health of the subsequent offspring cannot as yet be definitely stated

MATERIALS AND METHODS OF SECURING RECORDS

In order to secure the records of as large a number of human pregnancies associated with pelvic irradiation as possible (previously unreported) letters were sent to over seventeen hundred members of the four following organizations: (1) The American Gynecological Society, (2) The American Roentgen Ray Society, (3) The American Radium Society, and (4) The American Association of Obstetricians, Gynecologists and Abdominal Surgeons.

The members of these organizations were asked to report whether they had ever observed any pregnancies in women who had received pelvic irradiation, the treatments having been given either before or during the pregnancies concerned. To those observers who stated that they had had such experience, detailed questionnaires were then sent and they were asked to give particular attention to the following points:

1. Number of children of irradiated mothers.
2. Whether radium or the roentgen ray was employed.
3. The approximate dosage.
4. Condition of the child at birth, presence of abnormalities, etc.
5. The length of time the child had been under observation.
6. The health of the child since birth and at the last observation.

Details were also requested concerning early death, weakness, or any tendency toward disease, together with a report of any mental or physical abnormality that might have been observed at any time. In addition, information was requested as to whether the treatment preceded or followed conception, and in either case the physician was asked to state the interval of time that elapsed between the treatment date and the day of birth. Our thanks are due the many physicians who, in returning our questionnaires, co-operated so generously in making this study possible.

these cases by the more serious nature of the lesions observed in the children of the women receiving postconception treatment. In this latter group a large number of children presented serious developmental defects affecting chiefly the central nervous system and especially the higher psychic centers. Microcephaly following postconception irradiation was a common finding. Other gross structural defects were also found among the children of the women irradiated during pregnancy, whereas both the frequency and the seriousness of the damage observed were much less marked in the offspring of the women who received preconception irradiation. The conclusions arrived at from this study of the human case reports found in the current medical literature were as follows:

1. Irradiation of pregnant women is a procedure extremely dangerous to the health of the offspring (61.3 per cent defective) and should not be undertaken unless the existing pregnancies are to be terminated artificially prior to the period of viability of the child.

2. Whether preconception maternal pelvic radium treatment or roentgen irradiation is or

TABLE II—RELATIVE FREQUENCY WITH WHICH PELVIC RADIUM AND ROENTGEN IRRADIATION WERE EMPLOYED

| | |
|----------|-----|
| Radium | 15 |
| Roentgen | 129 |
| Total | 44 |

TABLE III—RADIUM EXPOSURES ARRANGED ACCORDING TO DOSAGE INDICATING FREQUENCY WITH WHICH VARYING SIZED EXPOSURES OF PELVIC RADIUM IRRADIATION WERE ASSOCIATED WITH PREGNANCY

| Am
m | t
f | p | e | N mb
p 750 | of
t d |
|---------|--------|-----|---------|---------------|-----------|
| 200 | | | | | 9 |
| 300 | | | | | 12 |
| 400 | | | | | 6 |
| 500 | | | | | 3 |
| 600 | | | | | 7 |
| 700 | | | | | 2 |
| 800 | | | | | 3 |
| 900 | | | | | 1 |
| 1 000 | | | | | 3 |
| 1 100 | | | | | 2 |
| 1 200 | | | | | 20 |
| 1 300 | | | | | 0 |
| 1 400 | | | | | 1 |
| 1 500 | | | | | 3 |
| 1 600 | | | | | 0 |
| 1 700 | | | | | 0 |
| 1 800 | | | | | 2 |
| Total | | | | | 74 |
| P t | pt | t m | ll th p | pt | |

ANALYSIS OF MATERIAL

The data bearing upon the previously unreported pregnancies are presented in abstract form in the accompanying tables and diagrams. The large amount of this material prevented its publication in greater detail. In certain instances percentages taken from the recent review of the literature have been incorporated in the diagrams for purposes of comparison and in order to emphasize the points under discussion. For convenience of presentation the material is discussed under the following five headings:

1. The health of the irradiated woman before treatment

Factors concerned with the technique of treatment

3. The effect of the irradiation upon subsequent fertility

4. The influence of the treatment upon the abortion rate

5. The relation of the irradiation to the health of the subsequent children

THE HEALTH OF THE IRRADIATED WOMAN BEFORE TREATMENT

Data concerning either the general health of the irradiated woman prior to treatment or

TABLE IV—PRECONCEPTION RADIUM EXPOSURES ARRANGED ACCORDING TO AMOUNT OF TREATMENT IN MILLIGRAM HOURS AND NATURE OF THE LESION FOR WHICH THE TREATMENT WAS INDICATED

| R d m
xpos
mpl y d | Myo-
p th
hem
rh g | My m | Olig m
hæ | Am hæ | T t l |
|--------------------------|-----------------------------|------|--------------|-------|-------|
| 200 | 3 | | 3 | | 6 |
| 300 | 7 | | 1 | | 9 |
| 400 | 1 | 1 | 2 | | 4 |
| 500 | 1 | | | | 1 |
| 600 | 1 | | | | 1 |
| 700 | 2 | | | | 2 |
| 800 | | | | | |
| 900 | | | | | |
| 1 000 | 3 | | | | 3 |
| 1 100 | | | | | |
| 1 200 | 1 | | | | 1 |
| 1 300 | | | | | |
| 1 400 | 1 | | | | 1 |
| 1 500 | | 1 | | 2 | 3 |
| 1 600 | | | | | |
| 1 700 | | | | | |
| 1 800 | | 1 | | | 1 |
| Total | 20 | 3 | 6 | 2 | 31 |

N t th t p g h f ll w d xp su h gh s m ll
g m th s th gh p p gn h h xp oc d ft xp m ll f
m th s th gh pt wh my m t w p t t

the reason for the irradiation exposure were not requested in the questionnaire. No information was received that dealt with the general health of the patient, but as shown in Table I 131 observers stated the indication that led to the use of radium or the roentgen irradiation as the case might be.

The majority of the exposures were given apparently for functional uterine hemorrhage not associated with any gross pelvic lesion, whereas not a few of the treatments were administered because of the presence of uterine myomata. As will be noted the majority of the exposures were directed at some local pelvic disturbance although in several instances

the irradiation was employed in an attempt to induce sterility because of systemic disease

It should be remembered here that when evaluating the influence of maternal irradiation as it may influence the health of the subsequent child practically nothing appears to be known concerning the relationship that may exist between local pelvic disturbances such as functional uterine hemorrhage and the future health and development of the subsequent offspring

FACTORS CONCERNED WITH THE TECHNIQUE OF TREATMENT

Sources of radiant energy and the dosages employed In the series of treatments reported in Table II radium and the roentgen ray were used with about equal frequency and from a study of the end results their effects appear to have been identical

A consideration of roentgen dosage as it may have influenced the reproductive process has been omitted for several reasons the small number of reports giving information on this point the incompleteness of the data recorded and the variations in the technique employed Radium treatments on the other hand were recorded more frequently and in a more uniform manner The records show that the majority of these treatments were given in the uterine canal whereas most of the operators employed a uniform filtration process and in general the same technique These facts made it possible for us to subject the radium dosages to an analytical study and for that reason they have received more consideration throughout this communication

As is shown in Table III the radium dosages varied in amount from 200 to 1800 milligram or millicurie hours (the two terms being employed interchangeably in this paper) Most of the treatments were given in exposures of milligram hours as expressed in even hundreds as is also shown in Table III In the few instances in which the amount of irradiation did not fall on the hundred mark it was assumed for the purpose of this study to be the same as that of the nearest hundred and was so tabulated

The most striking point brought out by a study of Table III is the fact that pregnancy

should take place after so large an exposure of radium as 1800 milligram hours when permanent sterility is known not infrequently to follow large pelvic radium treatments in which little more than one third of that amount was administered Human ovaries apparently vary greatly in their sensitivity to radium irradiation as usually applied in the uterine canal

It was further brought out that the nature of the lesion present might have had some influence in permitting pregnancy to occur following the higher of the doses recorded It was presumed that the patients becoming pregnant following the higher dosages may all have had large myomata which might so greatly have increased the distance between the point of application of the intra uterine irradiation and the ovaries as to weaken the influence of the radium upon these organs For this reason the data concerning the pathological lesions present and the various doses employed were combined in Table IV They were so arranged as to show the relationship that exists between the size of the dosage and the nature of the lesion present From what has been said it is evident that the truth of the presumption just mentioned is affirmed since one patient who became pregnant after an exposure of 1800 milligram hours *did* suffer from myoma uteri whereas two pregnancies took place following exposures of 1500 milligram hours in which uterine myomata were not present

The influence of the time of the treatment upon the health of the child As was shown in the recent review of the literature the time of the pelvic irradiation with respect to the date of conception was the most important single factor to be considered when the possibility of damage to subsequent offspring due to maternal irradiation was estimated In the present study the influence of the time of treatment is dealt with in detail under the heading The Relation of Irradiation to the Health of the Child It may however be said here in passing that when the pregnant woman is irradiated the greatest amount of or perhaps all the damage done probably results from the direct embryonic irradiation with little or no damage due to the indirect effect of the irradiation upon the internal secretion of the ovaries In

the case of preconception ovarian irradiation any damage that may be produced probably is the result of direct action of the treatment upon the unfertilized ovum. That such irradiated ova would not die as a result of the treatment, but would in spite of damage have the power to become fertilized is hard to realize. On the other hand it can quite easily be conceived that the directly irradiated growing embryo might be partially damaged and yet go to term.

THE EFFECT OF IRRADIATION UPON SUBSEQUENT FERTILITY

In 79 of the full term pregnancies the time in months between preconception treatment and delivery were recorded (Table V) irrespective of the amount of irradiation employed. From these figures the length of the intervals between the treatment and the time of conception can be estimated approximately if desired. This would indicate the length of the so called 'sterility period' which might be due in part to the irradiation treatment although in most instances it would probably be due just as much to the nature of the local pelvic lesion for which the irradiation was employed. From this table it appears that most of the deliveries (65 of 79) took place within 3 years from the date of treatment whereas 54 of the 79 deliveries occurred within 4 months.

The relation between the amount of irradiation and the length of the so called 'sterility period'

In 37 cases data were available concerning both the exact amount of radium exposure employed and the length of the interval in months between treatment and delivery. These facts have been recorded graphically in Figure 1. The base line represents the various dosages as expressed in milligram hours whereas the vertical line indicates the interval in months occurring between the time of treatment and the date of birth. Along the polygon curve will be found the number of women treated for each of the doses recorded immediately below on the base line.

The interval between treatment and birth appears to lengthen as the amount of radium exposure increases from 200 to 500 milligram hours whereas beyond the 500 point no con-

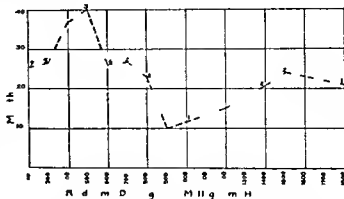


Fig. 1. Preconception radium irradiation: the relationship of dosage to delivery date in full term pregnancies. The base line indicates the different amounts of intra uterine radium exposures received by 37 women. The vertical line shows the interval in months between the treatment date and the date of delivery. The number of women receiving the various doses as outlined on the base line is recorded along the polygon curve. As the amount of exposure increases up to 500 milligram hours the interval between treatment and delivery also increases. This relationship however is not constant after the 500 mark has been passed.

stant relationship between the two seems to exist.

THE INFLUENCE OF THE TREATMENT UPON THE ABORTION RATE

Since pregnancy is not a condition registered by law, it is practically impossible to determine the abortion rate for the population at large. Certain statistics referred to in our recent publication indicate that in certain central European cities the abortion rate is usually about 33 per cent.

According to the figures given in Table VI in 305 pregnancies reported here which were associated with maternal pelvic irradiation 73 (23.9 per cent) abortions took place irrespective of whether the treatment preceded or followed conception (excluding 22 pregnancies where treatment time was unknown—Table VII).

In Figure 2 are shown the relative abortion rates for (1) the non irradiated population, (2) the irradiated women as previously reported, and (3) the rate for the present group of 305 irradiated women. This chart would seem to indicate that maternal irradiation has no effect in increasing the abortion rate.

The abortion rates for the irradiated women as shown in Figure 2, were computed irrespective of whether the maternal irradiation was

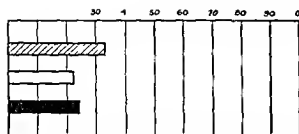


Fig. 2. The abortion rate as influenced by the maternal age at the time of irradiation. The horizontal bars show the abortion rate for no irradiation of women of each age. Continuation of the bars shows the abortion rate for the 320 irradiated women. The black bars represent the abortion rate for the 35 pregnancies terminated by the patient. Note that the abortion rate is high for the 30 and 4 year age groups, but is low for the 50, 60, 70, 80, 90, and 0 year age groups. The abortion rate is also high for the 30 and 4 year age groups, but is low for the 50, 60, 70, 80, 90, and 0 year age groups.

employed prior to or coincident with the pregnancies concerned. Since the abortion rates after irradiation shown in these two series of pregnancies were not increased as a result of the treatment the amounts of exposure must necessarily have been less than those which are commonly employed when therapeutic abortion is attempted by this means.

The influence of the time of treatment upon the abortion rate with respect to the date of conception. As was just shown pelvic irradiation *per se* has little if any effect upon the abortion rate when this is considered irrespective of whether the treatment took place before or during pregnancy. When however the time element is considered we find a variation in the abortion rate a fact which is of interest. It is true of course that the figures at our command in this connection are small and therefore tend to nullify our conclusions but taken as they stand (Table VII) they show that (1) where the irradiation takes place during pregnancy (3 abortions in 53 of the pregnancies) the abortion rate is approximately 43.3 per cent whereas (2) in the 230 cases where the treatment preceded pregnancy there were approximately only 50 abortions a rate of but 21 per cent.

THE INFLUENCE OF IRRADIATION UPON THE HEALTH OF THE CHILD

The health and physical development of the children born at or near term of irradiated

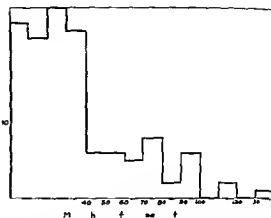


Fig. 3. Observation time of children of irradiated mothers. The horizontal bars indicate the number of months of observation of each child. The vertical line shows the number of children observed up to each period of months recorded on the basis of 10 months. Note that the greater number of these children were under observation for only 4 months while the remainder were observed up to 17 years.

mothers is the most important consideration in the present study. Table VIII shows that of 33 full term children 37 or approximately 15.4 per cent at some time while under observation presented evidence of defective health or of underdevelopment.

The term unhealthy child defined. The dividing line between normal health and development and conditions that might be regarded as subnormal is a very fine one and is drawn only with great difficulty. In fact under no other circumstances is the distinction fraught with more difficulty than in the present case. For the purpose of this investigation it has been found necessary to set up an arbitrary standard by which to measure the health of children born of irradiated mothers. Thus children who were born at or close to term and who presented at any time while under observation any disease or defect mental or physical or who died while under observation from whatever cause have been classified as *unhealthy*. By supplying so elastic a definition of the term unhealthy child it was believed the reader would be able better to appreciate the difficulties encountered in this selection and would also be led to understand more readily the relationships that might or might not appear to exist between the health of the children described and the health and treatment of their respective mothers.

TABLE V—PRECONCEPTION RADIUM AND ROENTGEN TREATMENTS—TIME INTERVAL BETWEEN TREATMENT AND DELIVERY

| Time interval | Number of treated | | |
|---------------------------|-------------------|-------|-------|
| | Rad m | Rtg y | Total |
| Under 13 months | 8 | 5 | 13 |
| 13 to 24 months inclusive | 27 | 14 | 41 |
| 25 to 36 months inclusive | 4 | 7 | 11 |
| 37 to 48 months inclusive | 8 | 1 | 9 |
| 49 to 60 months inclusive | 1 | 2 | 3 |
| 84 months | 2 | 0 | 2 |
| Totals | 50 | 29 | 79 |

The following table shows the results of the postnatal examination of the children of the mothers who received radium or roentgen treatment during pregnancy. The results are given in the following table:

Duration of observation of children of irradiated mothers In 131 instances the duration of observation in months was definitely recorded. It will be seen from Figure 3 that the greater number of these children were under observation for only about 40 months although several were observed over a period as long as 17 years. Our reports therefore can cover only the earlier part of the lives of most of these children. It cannot be stated in what manner or to what extent these individuals may suffer in later years because of the maternal irradiation preceding their births.

A consideration of the so called 'unhealthy children' In Tables IX and XI a few important points are presented concerning the unhealthy children resulting from the 305 pregnancies recorded here (Table VI).

The records of the unhealthy children have been arranged in two groups. In Table IX have been placed those few children whose mothers received irradiation at some time during pregnancy whereas the larger number of unhealthy children are reported in Table XI, those cases in which the mothers received preconception irradiation.

Postconception pelvic irradiation As is shown in Table VII 53 women received postconception irradiation. Twenty three of these women

TABLE VI—ABORTION FREQUENCY IN IRRADIATED WOMEN

| | |
|-------------------------------------|------------|
| Number of pregnancies reported upon | (100%) 305 |
| Spontaneous abortions | (23.9%) 73 |
| In first pregnancies | 61 |
| In second pregnancies | 9 |
| Order of pregnancies not stated | 3 |

The following table shows the results of the postnatal examination of the children of the mothers who received radium or roentgen treatment during pregnancy. The results are given in the following table:

TABLE VII—THE ABORTION RATE AS INFLUENCED BY THE TIME OF TREATMENT

| | Time interval (months) | Spontaneous abortions (%) | Operative abortions (%) | Total (%) |
|-------------------------|------------------------|---------------------------|-------------------------|-----------|
| Treatment time recorded | 22 | 23.0 (100%) | 53 (100%) | 305 |
| Spontaneous abortions | 0 | 50 (21%) | 23 (43.3%) | 73 |
| Operative abortions | 0 | 2 | 0 | 2 |
| Ectopic pregnancies | 0 | 1 | 0 | 1 |

The following table shows the results of the postnatal examination of the children of the mothers who received radium or roentgen treatment during pregnancy. The results are given in the following table:

aborted, while 12 (40 per cent) of the remaining 30 went to term and bore unhealthy children (Table IX) or children who were classified as unhealthy according to the definition previously arbitrarily determined upon for the purposes of this study. In the majority of these cases the treatments were given by means of the roentgen ray. Most of these pregnancies were unsuspected at the time of treatment. The children were under observation for a long enough period of time and the nature and seriousness of their disturbances were such as plainly to indicate the existence of impaired health or defective development.

As was shown quite conclusively in the recent review of the literature irradiation of the developing embryo, whether animal or human is extremely likely to end disastrously while in both cases the damage most frequently found was observed in the central nervous system. In the group of unhealthy children reported upon in the present paper underweight at birth, microcephaly, blindness, hydrocephalus, Mongolian idiocy, and other gross defects of structure and function were observed, the

TABLE VIII—HEALTHY AND UNHEALTHY CHILDREN BORN OF MOTHERS WHO RECEIVED PELVIC RADIUM OR ROENTGEN IRRADIATION AT SOME TIME PRIOR TO BIRTHS OF THESE CHILDREN ARRANGED ACCORDING TO THE SEQUENCE OF THE BIRTHS AS THEY FOLLOWED THE MATERNAL TREATMENT

| | | | | | | | | | | | |
|----|----|----|------|------|----|----|---|---|---|----|----|
| N | ml | ff | ll | t | mp | | | p | t | l | 3 |
| N | l | f | h | l | | | | | | | 33 |
| I | t | p | g | | | | | | | | |
| | | ll | lthy | h | ld | | | | | | |
| | t | l | h | lthy | h | ld | | | | | 3 |
| S | | d | p | h | c | | | | | | |
| | | ll | lthy | l | li | | | | | | |
| | t | l | h | lthy | h | ld | | | | | |
| Ih | t | p | g | | | | | | | | |
| | | ll | lthy | h | ld | | | | | | 4 |
| | l | l | h | lthy | h | ld | | | | | 1 |
| I | | th | p | h | c | e | | | | | 1 |
| | | ll | lthy | h | ld | | | | | | 1 |
| | t | l | h | lthy | h | ld | | | | | 0 |
| Th | l | d | m | d | p | | f | h | h | l | 1d |
| f | h | h | h | l | r | d | h | h | p | en | 7 |
| | | | diat | d | | b | h | h | | | |

majority of them involving the central nervous system. It would therefore seem not unlikely that most of the disturbances of the developmental processes at least of the children described in Table IX might readily be attributed to the postconception maternal irradiation.

Postconception irradiation the influence of the time of treatment upon pregnancy and the health of the children born at term. In 24 of the instances where postconception irradiation was employed the month was stated during which the treatment was given. This information was shown in Table X. If a series of treatments was employed the month of the first treatment only has been recorded. The number of cases reported here is small and most of the treatments were received in the first third of pregnancy. From a study of this table it will be seen that 1 of the pregnancies ended normally (approximately 50 per cent). Of the pregnancy ending abnormally it will be noted that most of them occurred following irradiation taking place prior to the fourth month. However the appearance of a microcephalic idiot following irradiation as late as the sixth month points to the possibility of damage to

offspring when irradiation therapy is practiced at that period in the life of the fetus.

Preconception therapeutic irradiation. The unhealthy children born of mothers who received preconception pelvic irradiation are shown in Table XI. Of 30 women receiving such irradiation (Table VII) abortion took place in 50 (21.7 per cent). Of the remaining 180 full term pregnancies 27 instances occurred in which the children born of these women might be classed as unhealthy according to the definition of the term decided upon as a standard for the present study. These represented 15 per cent of the full term pregnancies. Here in spite of the larger number of women treated the frequency of birth of unhealthy children was much less (15 per cent against 40 per cent of unhealthy children born following postconception maternal pelvic irradiation).

A further study of these case reports (Table XI) reveals the absence of microcephaly among them. In many instances the disturbances observed were not serious and most of these could easily be explained on grounds other than the maternal irradiation. The various abnormalities of structure or disturbances of function differed more widely than those appearing in the children born following postconception irradiation. Again all the disturbances noted in this group appear also among the non irradiated part of the population hence none of them can be regarded as pathognomonic of irradiation damage. The proof here that the irradiation did not cause the damage is not definite but it is certainly far less circumstantial than is the case in which postconception irradiation was employed.

Infant mortality regardless of the date of the irradiation treatment with respect to conception. According to the figures shown in Tables IX and XI in the 232 full term pregnancies reported upon there were 11 infant deaths under one year of age. This represents a rate of 47 per thousand. The infant mortality rate for the year 1927 as determined by the Child Health Association¹ was 64.9 among each thousand babies born this representing the rate for the entire registration area of the United States. A comparison of these two

figures clearly indicates that there is no increase in the infant death rate that might be attributed to the maternal irradiation

GENERAL DISCUSSION

The difficulty in properly evaluating the influence of the irradiation In attempting properly to evaluate the importance of the part played by maternal irradiation in influencing the health and development of the subsequent offspring as in many other clinical and biological problems a number of other factors are concerned which make it extremely difficult to determine just what part the maternal treatment played in the production of the various disturbances observed. Some of the more important of these complicating factors are the following:

1 The comprehensive definition of the term unhealthy child as employed in attempting to differentiate between healthy and unhealthy children and the fact that no time limit was set in which disturbances of health or development might appear or death take place

2 The fact that practically nothing is known concerning the hereditary or environmental influences at work upon either the irradiated mother or her unborn child

3 Our ignorance concerning the effect of systemic or local pelvic disease as these may influence the health of children

4 The fact that all the different structural and functional disturbances occurring among the children of irradiated women have also been observed among the children of women not so treated. No conditions that might be regarded as pathognomonic of irradiation apparently have been observed among the children born of irradiated mothers

5 The difficulty of determining the frequency of the various anatomical and physiological abnormalities appearing among the children of non irradiated mothers as these occur spontaneously in the non irradiated population

6 Our lack of knowledge concerning the causes of many of the disturbances of health and development appearing among the children of women who have never received pelvic irradiation

TABLE IV—PATHOLOGICAL FINDINGS OBSERVED IN TWELVE CHILDREN IRRADIATED IN UTERO WITH EITHER RADIUM OR THE ROENTGEN RAY, TOGETHER WITH THE LENGTH OF TIME EACH ONE WAS UNDER OBSERVATION

| Case No. | R d m | R y | T m d t | D d | P t h l g c a l f i d g |
|----------|-------|--------------------|-----------|-----|--|
| 1 | | x | 20 months | x | Hydrocephalus |
| 2 | | x | 6 months | | Underweight at birth normal at last observation |
| 3 | | x | | | Microcephalic idiot |
| 4 | | x | Few days | | Malformation of upper extremities |
| 5 | | x | 8 months | | Blind and microcephalic |
| 6 | | x | 8 years | | Small anemic Condition not good at birth |
| 7 | | x | 2 years | x | Normal at birth death from intussusception |
| 8 | | x | 7 years | | Divergent squint |
| 9 | | Diagnosed by X ray | Few days | x | Cross between a Mongolian idiot and a cretin |
| 10 | x | | 12 years | | Microcephalic idiot |
| 11 | x | | 7 days | | Kept eyes closed blind (?) 2 1/2 pounds at birth |
| 12 | x | | 2 months | | 1 1/2 pounds at birth |

I N t e t h t t h l y d i g n o s t i c y w t h g t f h m o s t t
t h v i g b d t b y w m p l y d t h p t u r d

For these reasons our conclusions must necessarily be based upon generalities rather than upon specific data. In spite of this however, certain interesting conclusions may be drawn from the material that has been analyzed.

The proportion of unhealthy children of irradiated women Approximately 16 per cent of the full term children born of irradiated mothers reported upon in this communication were known to be unhealthy at some time while under observation. It was found to be impossible to secure for purposes of comparison any similar group of children whose mothers suf

TABLE X—RESULT OF TWENTY FOUR PREGNANCIES AS TO THEIR DURATION AND THE HEALTH OF THE CHILDREN BORN AT TERM IN CASES IN WHICH THE IRRADIATION WAS POSTCONCEPTION IN TIME AND THE MONTH WAS RECORDED DURING WHICH THE TREATMENT WAS GIVEN

| Age | | | Expo | | R I | | | |
|-----|---|---|------|-------------|-------|--------|---------|---|
| R | y | p | m | m h | N m l | Ab m l | N d b f | |
| | | | | F r t | 2 | | | |
| 5 | | | | S c o d | 3 | | | Def m d uppe
t m e
H y d o c e p h a l |
| | | | | S e n d | | | | p o n d s t b t h
b l i n d e |
| o | | | | T h d | 6 | 4 | | Ab t n f o t h
m n t h
2 D e d t y e
f o m n t u p
t n
3 I n t n a l q t
4 p u d a t b i t h
l t e o m a l |
| | | | | F t h | | | | O t t m e d |
| | | | | F f t h | | | | Ab t n |
| | | | | S t h | | | | Ab t n |
| | | | | S t h | | | | M o p h l d t |
| | | | | E a t h t h | | | | |

N t h t h g r t m b f d b f h l h h h
p g i l h g h d m g w p p t l b d f l w
m t l d i g h l u t h m h f g t

ferred from diseases resembling those found in the irradiated women but who had not received pelvic irradiation treatment. Even though such a comparison could not be made it would seem that a morbidity percentage of 16 among the children of irradiated women ought not to be regarded as excessive.

Without making a critical study of the various disturbances of health and development appearing among these children of irradiated mothers and without classifying the defective children according to the time at which the maternal treatment took place with respect to the date of conception we would be inclined to believe that maternal irradiation therapy had no injurious effect upon the health of these children if the frequency of such disturbances

were the only consideration to be kept in mind in arriving at a final conclusion.

A critical study of the defective children arranged according to the time of maternal treatment. When the nature of the defect or disturbance of health of each child is carefully examined (and these unhealthy children are grouped according to whether the maternal treatment preceded or followed conception) we are forced to the conclusion that the time of the irradiation is an important factor to be considered when we are attempting to determine the cause of the various disturbances of health and development that appear among these children. This belief is based chiefly on the facts that the higher proportion of the more serious disturbances fell into one group (that group being the one in which postconception maternal treatment took place) and that the frequency of these disturbances seemed to be much greater than would ordinarily be expected among the children of a similar sized group of non irradiated women. Furthermore in the children of the women who were irradiated during pregnancy the deformities seemed to conform to a type whereas in those cases in which the maternal treatment was given before conception this was not the case.

Although the frequency nature and uniformity of the disturbances occurring among the children of the women who were irradiated when pregnant strongly suggest that they were in some measure at least due to the maternal irradiation treatment we have no definite proof that this was the case. The health of the children previously reported together with the results of animal experimentation tend to substantiate the conclusions based upon evidence presented in the group of pregnancies recorded in this paper namely that postconception irradiation was an important factor in the production of the deformities under discussion. Beyond this point we cannot go in determining the relationship that exists between maternal pelvic irradiation during pregnancy and its bearing upon the health and development of the children irradiated while *in utero*.

Irradiation prior to conception. It is most important that we know whether or not pre

conception pelvic irradiation will injure the health or impair the development of subsequent children since as a rule radium and roentgen therapy are usually employed in gynecologic practice in the treatment of non pregnant women. A study of the table dealing with the health of children born following such preconception treatments (Table XI) presents an entirely different picture from that dealing with the children whose mothers received post conception irradiation. Approximately 11 per cent of unhealthy children were born following preconception irradiation as against 40 per cent of unhealthy children born following postconception irradiation. In the case of preconception irradiation these disturbances were not only less frequent but in the majority of instances were less serious in nature and did not tend to conform to a type. If from these findings any definite conclusions can be reached concerning the effect of preconception maternal pelvic radium or roentgen irradiation as it may influence the health and development of subsequent children it would be that such preconception maternal irradiation has little if any influence upon the health and development of any of these subsequent children.

Such a conclusion based upon a study of the health and development of the full term children (those born after preconception irradiation) would seem to indicate that the ova which were irradiated prior to conception either were killed before fertilization took place or if they became fertilized later aborted. Since the abortion rate among women receiving preconception irradiation is less than the rate in the general population it might be assumed that the irradiated ova were either uninjured or completely destroyed.

Conclusions If the foregoing theories namely first that postconception pelvic irradiation may seriously injure the health and development of the child *in utero* and second that preconception ovarian irradiation is not detrimental to the health and development of subsequent offspring are correct what practical bearing have such conclusions upon the future use of radium and the roentgen ray in the treatment of pelvic lesions in women of the child bearing age?

TABLE XI—PATHOLOGICAL FINDINGS OBSERVED IN TWENTY SEVEN CHILDREN BORN FOLLOWING PRECONCEPTION PELVIC RADIUM OR ROENTGEN IRRADIATION

| Cas N | R d m | R t g y | Time b t | De d | Pathological finding |
|-------|-------|---------|------------|------|---|
| 1 | | x | | x | Anencephaly |
| 2 | | x | Stillbirth | x | Knotted umbilical cord |
| 3 | | x | 1 week | x | Due to bronchitis |
| 4 | | x | 1 week | | Anæmic thin developed normally induced labor for eclampsia |
| 5 | | x | Stillbirth | x | Maternal eclampsia |
| 6 | | x | 99 months | | Congenital tracheal stenosis |
| 7 | | x | 60 months | | Congenital heart lesion |
| 8 | | x | 114 months | | Slightly under weight |
| 9 | | x | 138 months | | Learns poorly |
| 10 | | x | 8 hours | x | Immaturity |
| 11 | | x | 120 months | | Pulmonary tuberculosis |
| 12 | | x | 18 months | x | Pneumonia |
| 13 | x | | 1 day | x | Cause unknown |
| 14 | x | | 2 days | x | Cause unknown |
| 15 | x | | Stillbirth | x | Atelectatic cause unknown |
| 16 | x | | 12 hours | x | Maternal eclampsia with difficult labor |
| 17 | x | | 48 hours | x | Twin with the above |
| 18 | x | | 23 months | | Poor feeder not robust little resistance nothing definitely wrong |
| 19 | x | | 72 months | | Crooked tibiae later normal |
| 20 | x | | 17 months | x | Death from pleurisy |
| 21 | x | | 8 months | | Rickets |
| 22 | x | | 9 months | x | Death from bronchitis |
| 23 | x | | 33 months | | Weak and frequently sick |
| 24 | x | | 12 months | x | Pneumonia |
| 25 | x | | 24 months | | Slightly under weight |
| 26 | x | | | | Small at birth |
| 27 | x | | 6 months | | Feeding difficult |

Not healthy at birth

The first practical bearing is that postconception irradiation should not be employed during pregnancy if the child *in utero* is to be allowed to go to term for there is a 40 per cent likelihood that the child will present some

serious defect as a result. That such an opinion has not generally been held in the past even by leading gynecologists and radiologists is indicated by the fact that in a number of instances postconception pelvic irradiation has been employed in the treatment of uterine carcinoma complicating pregnancy, no attempt having been made to terminate the pregnancy at as early a date as possible after irradiation.

The second important conclusion drawn is that before irradiation treatment is undertaken it should always be ascertained definitely whether any woman about to receive such treatment is or is not pregnant. In order to obviate the possibility of pregnancy which might go on to term despite the manipulations or other procedures incident to the irradiation the uterus should be curetted. This is a further check against the existence of carcinoma of the fundus, a condition apparently overlooked in a high percentage of cases (Norris). In view of the findings in this and in our preceding paper it would seem that such care ought to be exercised in order to eliminate the possibility of irradiating an unsuspected living embryo.

SUMMARY BASED ON 283 PREGNANCIES IN WHICH THE TREATMENT TIME WAS KNOWN

POSTCONCEPTION PELVIC IRRADIATION

1 Fifty three women are reported upon who received postconception pelvic radium or roentgen irradiation.

2 Abortion occurred in 3 instances (4.4 per cent).

3 Of the 30 children born at term 12 (40 per cent) presented some more or less serious disturbances of health or development. These defects in many instances were quite serious and tended to conform somewhat to a type.

PRECONCEPTION PELVIC IRRADIATION

1 Two hundred and thirty pregnancies are reported upon occurring in women who received preconception pelvic irradiation.

Abortion occurred in 50 (17 per cent) instances.

3 Of the 180 children born at term 7 (15 per cent) presented some disturbance of

health or defect in development. These defects were much less severe than those occurring in the preceding group and did not conform in any way to a type.

CONCLUSIONS

1 It appears reasonable to suspect that certain of the gross structural defects found among children irradiated *in utero* result from such irradiation.

2 There is as yet no definite indication that ovarian irradiation prior to fertilization has any detrimental influence upon the health or development of any subsequent children.

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EFFECT OF BLOOD IN THE PERITONEAL CAVITY UPON THE PRODUCTION OF PERITONITIS IN ANIMALS

JOSEPH P SPARKS M.D. PEORIA ILLINOIS AND VERNON C DAVID M.D. CHICAGO
F mth S g ID p tm t FR h M dc I C fl g

BLOOD injected into the normal peritoneal cavity is slowly absorbed by the lymphatics as well as by the direct passage of the blood serum into the blood stream. Micro organisms injected into the peritoneal cavity of animals are also absorbed directly into the blood as well as being taken up by the peritoneal lymphatics thence to reach the blood stream by the way of the thoracic duct.

Very closely allied in structure and function are the pleural and peritoneal cavities and likewise the absorption of blood and micro organisms from the pleural cavity takes place much as it does from the peritoneal cavity.

The pleura and peritoneum may both be the seat of pyogenic inflammation and pathologically the inflammatory process in one may closely resemble that in the other.

Efforts are constantly being made by clinical and experimental study to lower the

incidence in these cavities of pathogenic infections which not infrequently follow operative procedures in them. Allen¹ of St Louis has recently shown that in guinea pigs blood which contained pyogenic micro organisms and which was injected into the pleura cavity produced empyema in a large percentage of his experiments. He logically stressed the point that to prevent the development of post operative empyema it is important that the pleura be dry after operation on the lungs.

Having in mind the numerous instances in which varying amounts of blood are left in the peritoneal cavity following abdominal operations such as gastric or bowel resection and pelvic operations in which absolute asepsis is not possible it occurred to us that it would be of interest to study the effect of blood in the peritoneal cavity on the development of peritonitis.

All D S S g Gy & Ob t g y l j

TABLE I—EXPERIMENTS ON DOGS

| A g | | B
P
d
m | Kind f b t | R k | A t p y |
|-----|------------------------|------------------|---------------------|---------------|-------------------------|
| N | Blood
inj
m
d | | | | |
| | s | | Bacill l | R m m d w l l | N g (s w k l t) |
| | | | B all l | R m m d w l l | N g u |
| 3 | | | Bacill l | D d m day | N g (p l) |
| | | | Bacill col | R m m d w l l | Kill d m th l t (p t s) |
| 5 | | | Bacill col | R m d w l l | N p f m d |
| 6 | | | Bacill coli | R m m d w l l | N p f m d |
| 7 | | s | Str ptooccus h m ly | R m m d w l l | N p f m d |
| 8 | | s | S pt h m ly | R m m d w l l | N p f m d |
| 9 | 20 | s | S ar l f t r p ooc | R m d w l l | Kill d s w k l t (p) |
| | | | Sc l l l p ooc | R m m d w l l | Kill d s w k l t (p) |
| | | | Str p ooccc h m l | R m m d w l l | N p f m d |
| | | | Str ooccc h m ly | R m m d w l l | N p f m d |
| 3 | 5 | s | St h looccus | R m d w l l | N p f m d |
| | | s | St h looccus | R m d w l l | N p f m d |
| 5 | 75 | | B all l | R m m d w l l | N p f m d |
| 6 | | | Bacill coli | R m m d w l l | N p f m d |

TABLE II—EXPERIMENTS ON RABBITS

| A t g | | B t l
p e
j t d
m | Ks d f b c t e a | R e l t | A t p y |
|---------------|-----------------------|----------------------------|------------------|-----------------|--|
| R b b t
No | Blood
i j t d
m | | | | |
| | 3 | 3 | B ill col | D d e t day | Slight p t t u s |
| 2 | | 3 | B ill l | D d t day | N g t |
| 3 | 3 | 3 | St phylcoc | R m n d w e l l | N t p f m d |
| 4 | | 3 | St phylcoccu | D d w k l t | S m l l m t f b l o o d y f l d i n p t a l
v i t y N f i b |
| 5 | 4 | 3 | St p t s | D d d y l t | F b i n u s p t t u s |
| 6 | | 3 | St p t o c c u | D d d y l t | F b i n p t o t u s |

TABLE III—EXPERIMENTS ON GUINEA PIGS

| Pig N | | | | | |
|-------|--|--|------------------------------|---------------|---------|
| | | | | | |
| | | | B ill l | R m n d l l | N g t |
| | | | Bacill l | R m d w l l | N g a t |
| 3 | | | St phyl lb | R m n d w l l | N g t |
| 4 | | | St phylcoccu lb | R m d l l | N g t |
| 5 | | | St e p t o c c u h a m l y t | R m n d w l l | N g t |
| 6 | | | St p t o c c u h a m l y t s | R m d w l l | N g t |

1 d i t t r l m l

Dogs rabbits and guinea pigs were used in our experiments. With the animal under ether anesthesia the abdomen and left thigh were surgically prepared the femoral artery was isolated and blood taken therefrom. This blood together with a broth suspicious of bacteria was injected into the peritoneal cavity. For controls bacteria alone were injected into the peritoneal cavities of animals. The results are summarized in Table I dogs

Table II rabbits and Table III guinea pigs

CONCLUSION

From the results of these experiments we are led to conclude that autogenous blood together with varying types of pathogenic micro organisms injected into the peritoneal cavity of dogs rabbits and guinea pigs does not predispose to the production of peritonitis

THE CAUSATION OF INTRACRANIAL AEROCELE BY BRAIN-FLAP

AN EXPERIMENTAL PROOF

ARNOLD K HLNRY MB B Ch (DUBL) FRCSI CAIRO EGYPT
P f so f Chn al S g ry Uni y f Egypt

AND

REGINALD ST A HEATHCOTE DM B Sc (OXON) CAIRO EGYPT
P f so f Pharm l gy Uni ty f Egypt

IN 1913 Luckett recorded the presence of air within the cranial cavity after fracture of the skull. A number of traumatic cases with collections of intracranial air have since been described and 10 of these were studied by Bullock in a recent article¹

The condition has been variously termed intracranial arocele or pneumocele pneumocephalus and in Luckett's first case in which the air was intraventricular pneumoventricle. In every case the air which had entered the cranial cavity as a result of fracture has been visualized within the dura.²

Up to the present time the causation of intracranial arocele has remained a matter for conjecture. Several authors have suggested that air from a fracture involving a sinus may be forced into the cranial cavity by the effort of sneezing or of coughing but the condition has occurred in cases in which the site of the fracture has been remote from any sinus.

BRAIN FLAP

In 1923 one of us (A. K. H.) had the opportunity of hearing Sir William Wheeler describe a case of intracranial arocele in which during an operation for decompression he noticed a large excursion of the brain which synchronized with respiration. A week later when by good fortune it was possible to time a similar excursion in the course of an operation for hydrocephalus performed by Mr Adams McConnell it became clear that the brain receded from the opening in the skull

during inspiration and bulged out with each expiratory act.

The suggestion that these to and fro movements of the brain might be directly linked with the presence of air within the cranial cavity at once became difficult to resist. It was not however until 1927 that it was possible for us to investigate the matter experimentally. For this it was essential in order to produce the movements at will to examine first the conditions under which they appeared. The results of our experiments on these movements for which we have coined the term brain flap have already been published (4).

In this paper we showed (a) that the movements of the brain are exactly synchronous with those of respiration (b) that they are not dependent on the systemic blood pressure except in so far as an excessive rise of blood pressure can abolish them and (c) that they depend for their appearance on large respiratory changes of pressure in the thoracic cavity. What relations might exist between intracranial pressure and brain flap we left for further experiment.

This problem has since been investigated and though our work is not yet absolutely complete we have become convinced that the phenomenon of brain flap depends on two factors themselves unconnected a low intracranial pressure and the presence of an impediment to the free flow of air into the thorax. We hope in the near future to publish our proof of the relation of brain flap to low intracranial pressure.

If a low pressure prevails within the cranial cavity the changes of intrathoracic pressure which result from breathing against resistance can induce maximal changes in brain volume. These changes of volume which

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ppe d B was wr w f s as by A J Lew h
Cb in 83 -an d th d cr b d by L h t
l d un l ty d ser p w b m d p t m ts
f th arachn d This m mb is in h d po t m ts
h t f m th po t f v i f p m l w k th tw m y b
cons f d as in l tru t In tr an mical fact mos intra-
cran al eroe l ar d p th ssoid m mb th gh oc
nally as in Co cas th ar m th bd al pac

synchronize with respiration and constitute brain flap are due to a pump like action on the venous intracranial blood. Thus, on inspiration is sucked out of the skull by the fall of intrathoracic pressure and regains its normal volume when on expiration the pressure in the thorax is restored.

We have found that the simplest method of inducing brain flap in the dog is to bleed the animal removing from 100 to 200 cubic centimeters of blood. As soon as this bleeding has taken place brain flap appears whenever the airway is obstructed either by the presence of mucus or by closure of the tracheal cannula employed for the administration of ether.

In this connection we would point out that Becht has shown that hæmorrhage causes a marked reduction of intracranial pressure. Again in four cases of intracranial aerocele in the series collected by Bullock special reference is made to a leakage of cerebrospinal fluid which must have greatly reduced the pressure within the cranial cavity.

EXPERIMENTAL METHODS

Our work has been carried out entirely on dogs of from 7 to 10 kilograms in weight. Under intratracheal ether insufflation the temporal muscle on one side was removed and a small opening was made in the skull with the Hudson drill. This instrument was selected because it stops on penetrating the inner table thus avoiding risk of damage to the brain or dura. We then opened the exposed dura by piercing it obliquely with a curved needle upon which the membrane was divided. Care was taken to avoid detaching the dura from the edge of the hole in the skull lest the membrane should cling to the moving brain and so prevent the ingress of air. From 100 to 200 cubic centimeters of blood were then removed from a femoral vein the amount varying with the size of the animal. The head was placed in such a position that the opening in the skull came about halfway in vertical height between the levels of the highest and lowest parts of the cranial cavity so as to allow such air as might enter to pass upward toward the base of the brain. Brain flap was then induced by the occlusion of the ends of the glass tracheal cannula.

EXPERIMENTAL RESULTS

In all ten experiments have been performed. The first of these was imperfect in that a precaution to which attention will be drawn later, was not observed. Six experiments have given positive results and the remaining three were control experiments.

In each of the six positive experiments brain flap was induced at roughly 5 minute intervals over a period of an hour. The opening in the skull was then sealed with a piece of plasticine, care being taken to avoid forcing air inward in front of the seal. The animal was then killed by an intravenous injection of chloroform. The temporal muscle of the other side was resected and the whole of the skin of the head and neck removed, to prevent confusion arising from bubbles of air which might come from the animal's fur. The head and neck of the animal were then totally submerged in water and a series of holes was made with the Hudson drill in both sides of the exposed skull care being taken to avoid opening the frontal sinus. The bony network which remained was cut through with bone forceps and removed without injury to dura or brain.

The dura thus exposed could be inspected and in some animals relatively large bubbles of air were seen beneath the membrane. In all the dura was then widely divided with scissors and a close watch was kept for escaping bubbles.

In some of our experiments the head had been rotated in such a way that part of the air which had entered the skull should move past the base of the brain through the subarachnoid cisterns and around to the surface of the opposite hemisphere. In all owing to the position in which the head was fixed it was likely that air would collect at the base of the brain. In order to demonstrate these collections the finger was inserted through one of the large openings in the skull and the brain was thoroughly broken up. In each experiment this procedure led to the emergence of further bubbles of air.

In every one of our six experiments in which brain flap was induced air was recovered in the way just described and in each it came from within the dura. In the last experiment,

which was made on a small dog the evacuated bubbles were collected in a measuring cylinder filled with water and the volume of the aerocele was estimated at 0.8 cubic centimeter.

This experimental aerocele at first sight seems too small to compare with the aeroceles of clinical practice but it must be remembered that the cranial capacity of even a large dog is small in comparison with the cranial capacity of man. We have found that in the dry skull of a dog similar in size to the largest used in our experiments the cranial capacity was only 75 cubic centimeters and in this skull an experimental aerocele of 0.8 cubic centimeter would occupy approximately *one per cent* of the intracranial space. Repeated experience with ventriculography in man has shown us that a clear radiogram of about three fifths of a lateral ventricle can be obtained with 15 cubic centimeters of air and the volume of the aerocele shown in figure 3 of Bullock's paper (which depicts some three fifths of an air filled ventricle) must therefore have been approximately 15 cubic centimeters. This moderately large aerocele in a human skull of 1500 cubic centimeters cranial capacity would occupy exactly *one per cent* of the intracranial space. It is thus clear that the volume of the tiny aerocele obtained by us in the dog is comparable with the much larger collections of air which have been visualized within the human skull.

In the first of our ten experiments air was seen beneath the dura and was allowed to escape under water in the way we have described. However as it had not then occurred to us to remove the skull cap under water we cannot exclude the possibility that this air may have entered as a result of lifting the dura away from the brain while removing bone. For this reason we have not counted this first experiment as either positive or negative.

CONTROL EXPERIMENTS

To avoid any possible source of error in our experimental procedure three other experiments were performed as controls. In these the practice was exactly as we have described *except* that the animal was not bled and brain flap was not induced. The same routine was as followed after the animal had been

killed and in none of the three controls was any air observed to leave the cranial cavity when the dura was opened or when the brain was broken up with the finger.

CONCLUSIONS

No long discussion of our results is called for as we believe that our experiments give a complete explanation of a manner in which an aerocele is formed within the cranial cavity. For this to occur there is required a compound fracture of the skull either in the base or vault which tears the dura in such a way as to produce an opening through which air may enter either from a sinus or from without.

There is further required a leak of cerebrospinal fluid or a loss of blood sufficient separately or together to reduce the intracranial pressure almost if not quite to atmospheric pressure. If now there is some impediment to the free entry of air to the thorax on inspiration this impediment combined with the existence of a low intracranial pressure will induce the condition of brain flap. Provided then that the dura mater in the region of the tear has not been stripped completely from the skull in such a way that it can cling to the moving brain the occurrence of brain flap must cause air to pass within the dura. It is clear that as the brain recedes from the dura mater on inspiration air will be drawn in to fill the space which is left and being lighter than the cerebrospinal fluid will tend to rise up through it under the dura. Again as the brain bulges on expiration it will tend to force out more fluid from the interior of the cranial cavity and so prepare a further space for air to fill. At the same time the recurrence of this to and fro movement of the brain will help to distribute the air which has already entered the subarachnoid space.¹

Brain flap thus supplies a mechanism which produces intracranial aerocele by aspirating air through a dural opening and in addition distributes the aspirated air within the dura.

Apo f h r m y f b dr out thr gh th d in
m g n d h th b leg f t h b d in xp d an eroc f
p u n f t u w h h w h a b xp d an eroc f
w h berr d m m h h t b b f f r w dr
t in h b os m l d

SUMMARY

1 Experiments have been performed in which air has been proved to enter the cranial cavity through an osteodural opening

2 In six experiments the condition of brain flap described in a former paper was induced and in each of the six air was found to have entered the skull and to be situated within the dura mater In three other experiments exactly similar except that brain flap was *not* induced no air could be found within the dura

3 An explanation of the rare clinical cases in which intracranial arocele has been found

is thus offered the causative mechanism being the condition of brain flap

In the performance of these experiments we have been greatly assisted by Dr K. Samaan M.Sc. Ph.D. It gives us very great pleasure to acknowledge the debt under which he has placed us and to offer him our thanks not only for that aid but for the spirit which prompted him to offer it

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CÆCAL DIVERTICULOSIS WITH SPECIAL REFERENCE TO TRAUMATIC DIVERTICULA

LOUIS A. GRENFSELDER M.D. F.A.C.S. AND ROBERT I. HILLER M.A. M.D. CHICAGO

From the Department of Surgery, L. K. F. D. D. B. N. I. M. S. I. T. F. M. D. I. R. H. F. H. M. H. I. R. H. P. A.

THERE are two types of solitary acquired diverticula of the cæcum primary and secondary. The secondary or traumatic type arises as a result of some operative procedure in the right lower abdominal quadrant whereas the primary type arises independently of such manipulation.

Primary solitary cæcal diverticula are rare. A survey of the literature however reveals cases reported by French, Jackson, Moschcowitz, Pereire, Potier, Razetti, and Satterlee. The diagnosis in most of the cases was appendicitis and the treatment consisted of drainage of an abscess or in the non acute case reported by Potier resection of the cæcum and ascending colon. Satterlee's patient died of intestinal obstruction. Spencer in 1921 reported a case of a spinster 44 years of age in whom the diagnosis of ovarian cyst had been made but who on operation was found to possess a solitary cyst of the cæcum. The cyst wall consisted of all of the layers of the cæcum and was of the normal cæcal thickness. It contained 4.5 liters of yellowish fluid. He believed that the cyst arose as a result of stasis in the colon. Cases are reported by Cooke and French in which a group of diverticula had become agglutinated and gave the impression of a single mass. Their cases were also mistaken for appendicitis. The diverticula reported above have occupied variable positions on the cæcum.

The etiology of these primary cæcal diverticula has not been satisfactorily explained. Discussions on the etiology of diverticulosis in general such as those by Lynch, Lane, Roberts, and Telling offer some suggestions in explaining the condition. The importance of the epiploic appendages, the loss of fat, the piercing of the intestinal wall by blood vessels which make tension and vary in their diameter from time to time plus a certain amount of intra intestinal pressure are stressed by them. However when one considers that 4 of the

cases of primary solitary cæcal diverticula mentioned above occurred in patients between the ages of 3 and 33 and that the location of the diverticula did not correspond with the appendices epiploicæ in each case he cannot be wholly satisfied with the explanations offered for diverticulosis of the large bowel in general. We should like to suggest another possibility though a congenital one as a factor namely the retention in some residual form of the appendix which appears early in embryological life but normally disappears before the true appendix develops.

Secondary or traumatic solitary diverticula of the cæcum occur probably much more frequently than do primary diverticula although the paucity of the literature would lead one to believe that the condition is very rare. In 1914 Bunts reported a case of a diverticulum occurring at the site of amputation of the appendix. He attributed its development to relaxation of the pursestring with eversion of the inverted portion of the gut after the stump had disappeared. Horsely in his book on operative surgery states that the pursestring method of appendectomy is an important factor in the etiology of diverticula. He quotes Bunts as ascribing the process to the destruction of the circular fibers around the base of the appendix by the pursestring suture. In 1917 Schlesinger reported 3 cases of cæcal diverticulum due to adhesions following operation. The adhesions were released but reformed in cases with a return of symptoms. In his discussion on the etiology of the condition he states that cæcal stasis was an appreciable factor in the development of a diverticulum.

We became interested in this subject about 2 years ago when we encountered a case of traumatic solitary cæcal diverticulum which we had diagnosed as stump appendicitis. We were amazed to discover that the diverticulum in this case bore no relation to the stump site

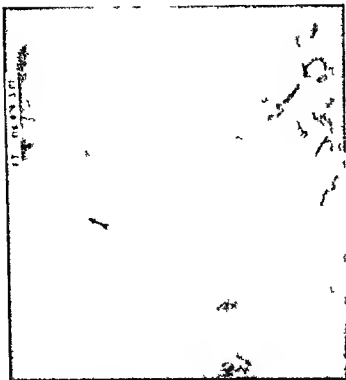


Fig 1 Gastro intestinal roentgenogram 48 hours after bismuth meal in case of solitary acquired diverticulum of caecum

but was present on the anterior surface of the caecum (Fig 1)

We determined to make a study of this condition to learn more about its etiology and to evaluate the claims of influence of operative technique on its development. This study included a survey of 5385 major operations and 400 adult autopsies which had been performed at the Michael Reese Hospital during the previous 20 months. Two diverticula were found at operation and two at autopsy. The autopsies included 3 cases in which appendectomy had been performed from 3 days to 20 years preceding death. Serial sections were made of the stump sites of 13 of these cases and single sections were taken from most of the others. In addition 18 dogs were operated upon. The first 5 were discarded. Of the remaining 13 7 were operated on by the ligature and drop technique and 6 by the purse string method. Serial sections were made of the stump sites of these 13 dogs, a total of approximately 1000 sections being studied. The results with their bearing on the etiology of traumatic diverticulum of the caecum are presented herewith.

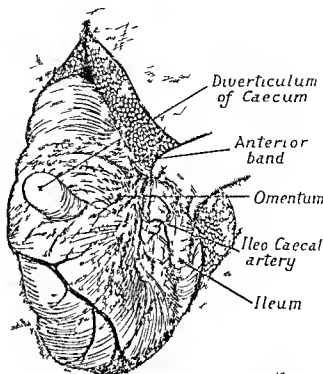


Fig 2 Drawing of a traumatic solitary diverticulum of the caecum due to an eversion of the bowel between two constricting bands of omentum. Appendectomy by the pursestring method had been done 23 years previously (Same case as shown in Fig 1)

Mr A M, age 46 years, merchant manufacturer, was admitted to the Michael Reese Hospital February 5, 1927. Appendectomy had been done 25 years ago. Patient had had gonorrhoea several times. He had been in good health up to 6 months before admission when he began to suffer with epigastric distress. This distress was characterized by a feeling of heaviness after meals relieved by belching. The distress was aggravated by greasy and rich foods. The patient was put on a bland diet but his condition became progressively worse. Nausea and vomiting appeared about one month before admission to the hospital. The vomiting followed meals and the vomitus consisted of undigested food followed by bile. Pain developed in the right lumbar region on the second day of this siege of nausea and vomiting. The pain was knife like in character, did not radiate but was aggravated by movement. This attack lasted about 5 days when the nausea and vomiting disappeared and the pain subsided. Patient was in bed for 9 days. About 2 weeks later pain appeared in the right upper and right lower quadrants of the abdomen. The pain in the right upper quadrant started suddenly; it was dull and continuous in character and bore no relationship to meals. The pain in the right lower quadrant was also dull and continuous. It was felt anteriorly when he bent forward but radiated to the back when he assumed an erect position. The right lower quadrant was sensitive to deep pressure. There was no history of heart burn, jaundice or marked loss of weight.

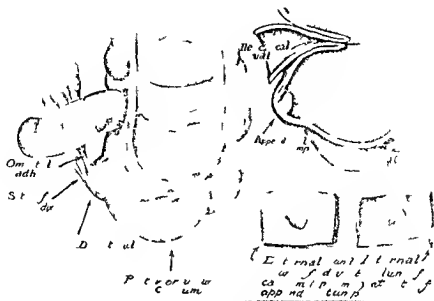


FIG. 3. Stomach and duodenum, pylorus, gall bladder, gall duct, common bile duct, appendix.

Stool were hard and bowel were constipated. He had pell of d nness at times epileptiform attacks. The preceding year. The attack occurred at night. Mrtal history, a negative latent mottled blood of c ncer of the stomach. f milt h t v oth s negati e. On physical examination the findings of note were a crr the right l er qu d ant and te derne to the right f the car just above the guinal ligament. Temperature 97 deg ee pulse 72 resp at on 8. Blood pressure 100-6. The urine contained some pus cells an occasional f l v granular cast and a few trace f albumin. Stool contained some shredded f mucus. Blood count hemoglobin 80 percent. Throcyte 4600000 leucocyte 12000 neutrophils 68 small mononuclear large mononuclear 5 t ritionals 5 W s e mann reacto as n g t e N n protein n trogen .44 and creatinin milligram per cubic centimeters of blood Metabolism - 5 percent. Gastric analysis. Endoneal pitted 45 minutes after administration. Free acid unit total acid 24 units of lct acid. Microscopic examination and further chemical min t ve n g t i.

Fluoroscopic examination revealed what appeared to be an appendiceal fistula very large stump that could be palpated and a quistly tender to palpation. It was better at 48 hours after the birth of the child than at 4. The roentgenographic examination confirmed the fluoroscopic findings. The stomach filled in normal. The colon was spastic. What appeared to be a small filled appendix could be seen lying along the medi-

aspect of the cecum (Fig. 3). The gall bladder films did not show gall bladder shadow. The dye test disclosed a well filling and normally concentrating gall bladder. However there was a distinct delay in the emptying time after fat meal. Patient was put on a fat free bland diet and discharged from the hospital February 7, 1937. His condition did not improve and by April 20, 1937 when he was readmitted for operation he had lost 9 pounds. The preoperative diagnosis was an appendiceal stump with pericæcal adhesions. At operation the condition depicted in Figure 3 was found. The omentum was adherent to the old abdominal incision. Several strands of mesentery tended down over the cecum and bulging out between the two of these strands on the anterior surface of the cecum was a diverticulum about 2 centimeters in length and about 1 centimeter in diameter. The adhesions about the diverticulum were lacerated and the diverticulum was verted with a pure t ing suture. The gall bladder was seen and palpated and seemed normal. The course following operation was uneventful and the patient left the present time 8 months after the operation in the best of health.

Communication with the surgeon who performed the appendectomy 5 years ago disclosed the following information as to the technique of the original operation. The mesoappendix was ligated and cut. The appendix was pushed into the cecum and ligature of plain catgut applied in the retrocolic omentum. The ileocolic junction was ligated. The appendix was amputated and the stump was sterilized and inserted.



Fig 4 Photomicrograph of section through the middle of a diverticulum at the appendix stump site S appendix stump M circular muscle Appendectomy one year previously by pursestring method Diverticulum produced by traction of an omental adhesion (Same case as shown in Fig 3) Hematoxylin eosin stain $\times 5$

The diverticulum in this case occurred away from the site of the appendix and was apparently caused by the eversion of the cæcum between two constricting strands of omentum

Miss B P age 38 born in South Dakota laboratory technician was admitted to the Michael Reese Hospital May 28 1927 as a private patient of Dr W S Priest complaining of abdominal pain and nausea of 3 years duration Three years ago patient had pain in the right lower abdominal quadrant at which time an appendectomy and hysterectomy for fibroids was performed in Milwaukee Wisconsin Almost immediately following operation the right sided abdominal pain returned and recurred intermittently thereafter It became worse about 2 months before admission and was associated with loss of weight loss of appetite fatigue and a general feeling of ill health The pain extended from the crest of the right ilium to the right costal margin occasionally radiating to the back It was not related to meals but was frequently relieved by food The bowels were usually regular but at times there had been alternating constipation and diarrhoea The attacks of pain were usually associated with nausea which of late had been sufficiently severe to keep her from her work She had never been jaundiced Stools had never contained blood She had had measles mumps chicken pox and pneumonia in childhood and a nervous breakdown 3 years previously She had not menstruated since the laparotomy On physical examination the only findings of note were marked tenderness in the gall bladder region and moderate tenderness in the right iliac fossa Rectal examination was negative Urine was entirely negative Temperature 98.4 degrees pulse 84 respirations 20 Blood count showed

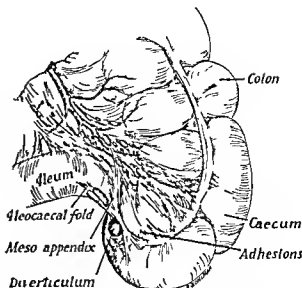


Fig 5 Diverticulum at appendix site Appendectomy by pursestring method 13 years previously Adhesions extend down on each side of the diverticulum

leucocytes 14 400 Coagulation time was 5 minutes Blood chemistry sugar 93 nonprotein nitrogen 35 and creatinine 1.3 milligrams per 100 cubic centimeters of blood Preoperative diagnosis chronic cholecystitis possible stump of appendix

Operation by Dr Ralph B Bettman May 28 1927 consisted in cholecystectomy and exploration of cæcum The stomach and duodenum presented no abnormalities The gall bladder was thickened and surrounded by adhesions It was dissected free of its adhesions and removed from above downward A muscle splitting incision was then made in the right lower quadrant and the cæcum was brought into view It was found that the appendix had been entirely removed but that some adhesions had



Fig 6 Photomicrograph of section through the apex of the diverticulum shown in Figure 5 T appendix stump M circular muscle LM longitudinal muscle Hematoxylin eosin stain $\times 35$



Fig 1 Photomicrograph of the diverticulum showing the mucosal lining and the underlying muscle layers. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture.



Fig 2 Photomicrograph of the diverticulum showing the mucosal lining and the underlying muscle layers. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture.

Figure 1 shows the base of the diverticulum, which is well-defined and has a regular, vertical, and somewhat elongated shape. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture.

On examination with the surgeon, the diverticulum was found to be a regular, vertical, and somewhat elongated shape. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture. The diverticulum is well-defined and has a regular, vertical, and somewhat elongated shape. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture.

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This case demonstrates a second means of diverticula formation by trauma, namely by traction of an adhesion.

Figure 3 portrays a diverticulum caused by traction of an adhesion.

The illustration represents the postmortem findings in the case of a woman 3 years of age who was operated on in New Orleans one year prior to her admission to the Michael Reese Hospital. She



Fig 3 Photomicrograph of the diverticulum showing the mucosal lining and the underlying muscle layers. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture.

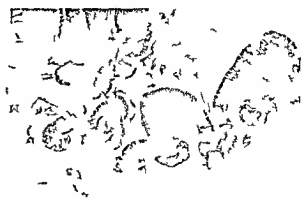


Fig 4 Photomicrograph of the diverticulum showing the mucosal lining and the underlying muscle layers. The diverticulum is located on the anterior wall of the cecum, and its base is well-defined. The surrounding tissue shows normal architecture.



Fig 11 Photomicrograph of section through the appendix stump area of a dog operated on 46 days previously by the ligation and pursestring method. *R* ileum. This figure along with Figures 12, 13, and 14 shows the migration of the pursestring into the bowel. *P* pursestring site. Hematoxylin eosin stain $\times 6$.



Fig 12 Photomicrograph of section through the appendix stump area of dog, operated on 46 days previously by the ligation and pursestring method. *P* pursestring site. *R* ileum. Hematoxylin eosin stain $\times 6$ (See Fig 11).

died of subacute bacterial endocarditis. Her history records no symptoms referable to the diverticulum. Figure 4 is a photomicrograph of a section through the middle of the entire diverticulum. The following reply was received in response to our request for a description of the appendectomy. The stump was inverted with pursestring suture. No ooc chromic catgut used. The stump was ligated before being inverted, plain catgut being used as ligature. No tissue was sewed over the site of the inverted stump. No other cæcal pathology was discovered at autopsy.

Figure 5 illustrates the findings in the second case of cæcal diverticulum discovered at autopsy.

The patient was a man 66 years of age who had been operated on in this city for acute appendicitis in May, 1915. He was admitted to the Michael Reese Hospital February 29, 1928, complaining of symptoms referable to the prostate. A prostatectomy was performed on March 12, 1928, and the patient died on March 10, 1928. There were no notes in his history indicating symptoms due to the diverticulum. A diverticulum of the bladder was discovered at autopsy in addition to other findings in the genito-urinary system. At necropsy, the intestines showed no evident gross pathology except that there were a few firm fine adhesions at the point of the cæcum where the appendix has been present and had been removed. At the stump of the appendix there was a small diverticulum with a thinning of the wall and a valve-like structure on the outer surface produced by a fold of serosa. The surgeon who performed the appendectomy advised that $\frac{1}{4}$ inch of the stump of the appendix was left; that the stump was ligated with catgut; that it was treated with phenol; that it was inverted with linen or silk

and that the meso-appendix was sewed over the site of inversion of the stump (Fig. 6).

This is another case representing the eversion of intestine between two strands of adhesions, but it differs from the case of A. M. (Figs. 1 and 2) in that the diverticulum occurred at the stump site and may well have resulted from a muscular defect as demonstrated in the photomicrograph. It probably corresponds with the case reported by Bunts. On the other hand as a result of our dog studies we can conceive of such a condition arising in cases in which the simple ligature and drop technique has been employed. Figures 7, 8, 9, and 10 illustrate the fate of the stump in this technique. These photomicrographs are of sections through the middle of stumps 2, 11, 25, and 58 days respectively after the date of the operation. In Figure 7 the stump has become retracted below the serosal level of the surrounding bowel. Figure 8 shows the stump site *S* much attenuated. In Figure 9 the process is even more exaggerated. In Figure 10 there is very little attenuation of the stump site but the circular muscle *M* has retracted as in the preceding three cases. The omental adhesions which were so marked in the earlier cases have become less marked at the expiration of 58 days.



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as demonstrated in Figure 10. With the actual stump site covered only by peritoneum adhesions and a strip of longitudinal muscle as illustrated in these figures one could readily conceive of eversion and diverticulum formation as a possibility following this type of operation.

As a result of our necropsy findings and our studies on dogs we feel that we can suggest two other methods of diverticulum formation at the stump site in addition to the eversion between two constricting bands and traction by an adhesion method first the eversion of the weak spot in the cæcal wall caused by the migration of the purse string into the lumen of the gut and second eversion of the weakened area in the cæcal wall resulting from a stump abscess rupturing into the cæcum. Figures 11 12 13 and 14 are from a series of sections of the stump site of a dog 46 days after an appendectomy in which the ligation and pursestring inversion technique was employed. *P* designates the pursestring site and *S* the stump site. When the specimen was examined the end of the pursestring was

hanging free in the lumen of the cæcum. In Figure 13 a diverticulum is just about to form.

Opponents of the ligation and inversion technique have emphasized the degenerative process occurring in the stump after inversion. Figures 15, 16 and 17 represent in a measure some of the early possibilities developing, respectively 3, 6 and 13 days after appendectomy by this technique. Figure 15 was taken from a section of a stump of a man who died a cardiac death 3 days after appendectomy. The autopsy revealed the omentum adherent to the right side of the cæcum and the neighboring parietal peritoneum. It was also adherent to the descending colon and its neighboring parietal peritoneum. The section demonstrates the early degenerative process in the stump, the injury to the circular muscle by the pursestring and the retraction of the cæcal mucosa following the application of a crushing clamp to the base of the appendix.

Figure 16 was taken of the middle of the stump area in the case of a man aged 55 who died of paralytic ileus 6 days after an explora-



Fig 15 Photomicrograph of section through the middle of appendix stump area of patient operated on 3 days previously. *M* circular muscle *S* stump *I* ligature about the stump *P* pursestring site. The circular muscle has been torn on one side by the pursestring. The mucosa has become retracted as a result of the application of the crushing clamp. The ligature is holding only the longitudinal muscle with its peritoneal covering. Degeneration has begun only about the periphery of the stump cavity. Hematoxylin-eosin stain $\times 20$.



Fig 16 Photomicrograph of section through the middle of appendix stump area of patient operated on 6 days previously. Degeneration of the stump was so far advanced that the fixation process of the specimen caused the gelatinous material to retract laterally, leaving an apparent artifact *A*. *S* stump site. *B* and *C* sites of the first and second pursestrings respectively. Cavity is sealed by only a thin layer of loose areolar and fibrous tissue. Hematoxylin-eosin stain $\times 8$.

tory laparotomy and appendectomy. Three days after the operation partial evisceration occurred followed by ileus with death 3 days later. The section has failed to include the soft gelatinous material which was present in the sections taken lateral to this point. In fixing the specimen the soft material which resulted from the necrosis and degeneration of the stump contracted and left an apparent artifact in the middle of the block. The points marked *B* and *C* represent the points of perforation of the 2 silk pursestring sutures used in this case. This section also clearly demonstrates the depth and flimsiness of the tissue which actually seals off the stump site from the peritoneal cavity and one ceases to wonder at the cases of abscess of the appendix stump which have ruptured either outward or inward. The autopsy findings in this case with regard to the intestines were as follows:

The operative wound is clean. There are a moderate number of easily broken down fibrinous adhesions in the region of the operative wound. The appendix has been removed and the operative field is clean. There are a few small fibrinous adhesions present here. The lesser pelvic cavity contains about 10 cubic



Fig 17 Photomicrograph of section through the middle of appendix stump area of patient operated on 13 days previously. He died of pulmonary embolism. Abscesses *A* have formed between the Lembert *L* and pursestring *P* sutures and about the stump *S* within the pursestring suture. *M* circular muscle. Hematoxylin-eosin stain $\times 5$.

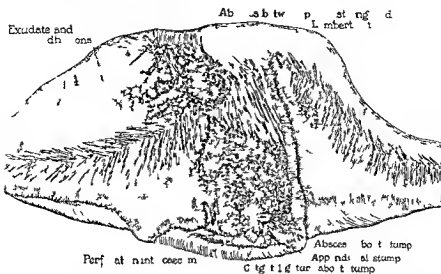


Fig 8 R co trut f ms ls t th gh the ppendi stump th
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fo t l p p d Abs c s h d f o m d b o t t h t m p a d b t e th
p t g d L m b t t t h e Th b s b o t t h t m p h d p e f t d i t
thel me f th cæ m (S m cæ e sh n F)

centimeters of thin blood tinged fluid. There are some small areas of fibrinous adhesions attached to several loops of small intestine which were in contact with the anterior abdominal wall. The small intestine is greatly distended by its content of fluid and is moderately dark blue in color and its inner vessels are slightly more prominent than usual. External examination of the large intestine and small intestine and stomach is otherwise negative.

Figure 17 is of a section taken from the appendix stump site in the case of a woman 30 years of age who died of pulmonary embolism 13 days after an appendectomy for an interval appendix.

Figure 18 represents a reconstruction of the serial sections of this specimen.

The patient was kept in bed for 3 days following her operation because of a low grade fever and a leucocytosis. Her temperature ranged from 100 to 102 degrees and the leucocyte count was 10,000. The situation on the case was not exactly satisfied by her condition. However, when the temperature came down to normal on the tenth day he allowed her up in the chair. When being put out the wheelchair for the first time she felt faint, her pulse became rapid and in 30 minutes she was dead. The necropsy revealed well healed crison old fibrous tuberculo of the left lower lobe fibrous adhesions of the right lung and an infarct 6 centimeters in

size and dimension. A huge thrombus was present in the pulmonary artery. It was 8 centimeters long and varied in diameter from 1 to 2 centimeters. The lumen was enlarged and bound to the anterior chest and abdominal wall by numerous adhesions. The omentum was adherent to the cæcum and surrounding tissue. When the cæcum was opened a protruding mass of reddish tissue about 2 centimeters in diameter covered the mucosa was found. When this was opened a flattened sac about 1 centimeter in diameter was seen. This sac apparently represented the appendiceal stump between the primary ligature and the pursestring suture. On the outer surface a number of adhesions were present. The right tube was also involved in the adhesions. No evidence of thrombosis was found in the inferior vena cava or in the veins about the cæcum or the incision. Microscopical examination of the specimen disclosed the fact that the small sac above described was an abscess and that another abscess existed between the site of the pursestring suture and the Lambert stitches. A small opening was also found extending into the cæcum from the abscess about the stump.

This specimen along with those portrayed in Figures 15 and 16 points the way to diverticulum formation by rupture of a stump abscess into the cæcum and a weakening of the wall at that point.

SUMMARY

Solitary cæcal diverticula may produce symptoms of acute or chronic appendicitis.

necessitating operation. Their presence should be suspected if appendectomy has previously been performed and symptoms recur.

The etiology of the primary type of diverticulum is still a matter of conjecture.

An extensive study covering observations on 5385 major operations and 400 adult necropsies performed at the Michael Reese Hospital has yielded 4 cases of traumatic solitary cæcal diverticulum: 2 at operation and 2 at autopsy.

Illustrations are presented to demonstrate etiological factors and possibilities in the formation of these diverticula: (a) eversion of the cæcum between 2 constricting adhesive bands; (b) traction of a narrow adhesion; (c) eversion at the stump site as a result of weakness due to the migration of a silk purse string into the cæcum; and (d) eversion at the stump site as a result of weakness following the rupture of a stump abscess into the lumen of the bowel.

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CLINICAL SURGERY

FROM THE NECKER HOSPITAL DEPARTMENT OF UROLOGY

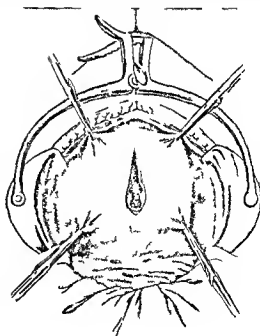
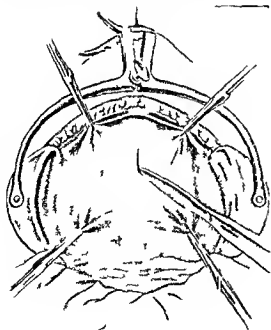
THE TRANSPERITONEAL CLOSURE OF VESICOVAGINAL FISTULÆ

PROFESSOR FELIX LEGUEU PARIS FRANCE
P f s o f U l g U I P

VESICOVAGINAL fistulæ in the past were often the result of poor obstetrics the patients in such cases giving the history of long neglected labors or of the application of high forceps on a floating head. With improved methods in obstetrics such a fistula is less common and today it may be said in many instances to be a postoperative complication of a radical operation for carcinoma of the cervix of a total hysterectomy for malignancy and fibroids or of a panhysterectomy for pyosalpinx. Vesico-vaginal fistulæ may follow the use of radium in the treatment of carcinoma of the cervix if the radium has not been sufficiently screened.

In the repair of vesicovaginal fistulæ the vaginal the paravaginal the transperineal the suprapubic extraperitoneal and the suprapubic transperitoneal routes are all used. The suprapubic route is the method of choice when the vaginal route has failed when the vaginal route is impossible or impractical on account of dense vaginal adhesions and when the fistulous tract lies high up in the vagina close to the peritoneum.

According to Howard A. Kelly & Trendelenburg was the first operator to use the suprapubic or transvesical route. His two attempts in 1881 and 1884 were failure. In 1885 he successfully closed a vesicovaginal fistula suprapubically. In



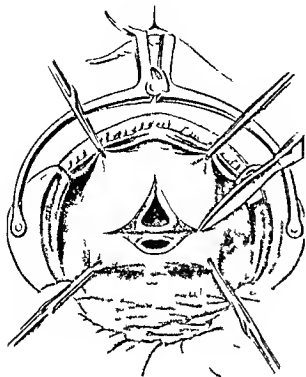


Fig 3 Step 3 The orifices are seen to be completely separated preparatory to their closure. Such fistulae are usually located in the midline

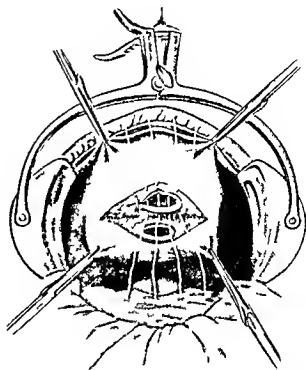


Fig 4 Step 4 The sutures have been introduced through the edges of the fistulous opening in the bladder wall. One of the sutures is already tied. The separate closure of the fistulous opening in the vaginal wall is shown in Figure 5

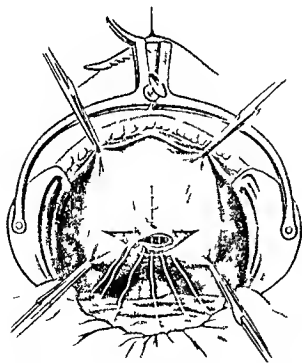


Fig 5 Step 5 The opening in the vaginal vault, being closed by interrupted sutures, one of which is shown tied. The incision through the peritoneal covering of the posterior bladder wall is closed with interrupted sutures

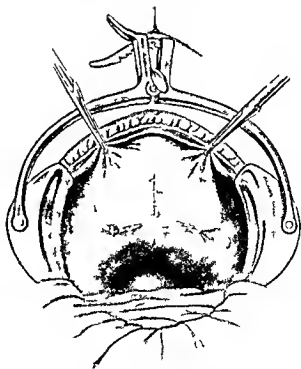


Fig 6 Appearance of peritoneal reflection after steps described have been approximated by interrupted sutures of fine chromic catgut. The incision in the abdominal wall is closed in the usual manner

1914 I operated upon my first case by the transperitoneal route. Since that time the method has been used in 4 cases and the results have been entirely satisfactory. There has been but one death.

TECHNIQUE

The steps of the technique may be described as follows:

Step 1. The patient is placed in an extreme Trendelenburg position; the abdomen is opened and a self-retaining retractor is inserted. The peritoneal fold which is reflected from the posterior bladder wall across the vaginal vault is then exposed and brought into view by means of four forceps as shown in Figure 1.

Step 2. An incision is next made in the median line through the posterior wall of the bladder (Fig. 1) and vaginal vault so as to expose the two fistulous openings. In the majority of cases postoperative vesicovaginal fistulæ are located in the midline; hence the openings are exposed with the first incision (Fig. 2).

Step 3. The vagina and bladder are separated by means of sharp dissection until the fistulous

openings are completely isolated as shown in Figures 3 and 4. The bladder is mobilized on all sides at a distance from the fistula.

Step 4. The openings in the bladder and vagina are closed with interrupted catgut sutures (Fig. 4). One must be careful to keep the suture lines of the vesical and vaginal orifices respectively as far apart as possible. This is one of the essential steps in the technique of the transperitoneal operation.

Step 5. The peritoneal edges are approximated with fine chromic gut and the incision through the abdominal parietes closed in the usual manner.

Recurrence of the fistula formation of phosphatic stones from the use of chromic gut sutures, postoperative peritonitis and cystitis are the more frequent complications.

The prevention of an overdistention of the bladder is an important point in the postoperative treatment of vesicovaginal fistulæ. A permanent catheter introduced into the bladder or catheterization every 4 hours will prevent overdistention.

FROM THE UROLOGICAL CLINIC WELLINGTON HOSPITAL NEW ZEALAND

SUPRAPUBIC CYSTOTOMY UNDER LOCAL ANÆSTHESIA

K CAMPBELL Begg MA MSc MD FRCS FACS FCSA WELLINGTON NEW ZEALAND
S. L. K. W. H. G. H. J. I.AND
C. I. V. ANSON MRCS (Eng) FRCI (Lond) WELLINGTON NEW ZEALAND
S. A. H. I. W. H. G. H. J. I.

In surgery implicating the urethra it is almost a cardinal rule that a satisfactory result can not be obtained unless the urinary stream is side tracked above the point where the work is to be done until the healing is more or less complete in this section. As in the majority of cases it is preferable to divert the urine from the bladder direct in order to leave a clear field over the whole urethra it is important that the procedure should be first as simple as possible in execution second involve little disturbance of the tissues and third be of such nature that the bladder will close quickly when the necessity for diverting the urine has ceased.

The method described differs from cystotomy for other purposes. For instance in the first stage of a prostatectomy it is essential to insert the tube as high up in the bladder as possible and also well above the symphysis pubis so as to give scope for the second stage of the operation. A more open dissection is required.

INDICATIONS

The chief indications for diverting the urine are in stricture of the urethra as a preliminary operation to the resection in ruptured urethra as a preliminary operation to the repair and in hypospadias as a preliminary operation to a plastic on the penis. It is also used in some cases in which the diagnosis is in doubt but in which it is essential to give relief to the patient by draining the bladder and incidentally to make possible cystoscopy by the suprapubic route if the ordinary method is not available.

The chief features are a small incision a small exposure of the bladder and the insertion of a Malacot catheter through a trocar and cannula of the Morson type. The operation is carried out under local anæsthesia by means of a field block.

PREPARATION OF THE PATIENT

No preparation in the way of purgatives or enemata is required. The pubes is shaved in the ordinary way and the skin is scrubbed with ether soap and finally painted with iodine or mer-

curochrome and acetone solution. Diet is not restricted but it is advisable to allow 2 hours to elapse between the taking of solid food and the operation. An injection of 1/300 of hyoscin and 1/6 grain of morphine is given in the ward half an hour before the patient is sent up. As the field block and its preliminaries usually occupy half an hour it is an hour after the injection before the first incision is made.

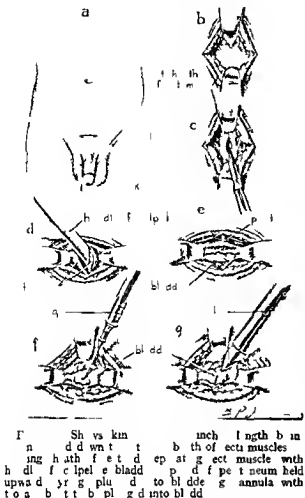
ANÆSTHESIA

The instruments necessary to produce the field block are a 10 cubic centimeter Labat syringe 0.50 and 80 millimeter Labat needles an enamel pannikin to hold 300 cubic centimeters enamel bowls each holding 300 cubic centimeters and a glass measure graduated in cubic centimeters.

The materials used are novocain powder in celluloid capsules each holding 0.3 grains (3 required) and adrenalin solution in glass ampoules of 1 cubic centimeter. There should be no discoloration in this solution. The syringe with plunger withdrawn and the needles with stylets in place are wrapped in gauze and placed in a basin of cold water brought to the boiling point and allowed to boil for 5 minutes. The two enamel basins and the pannikin are placed in boiling water for 5 minutes.

A small table is provided and draped with sterile towel. On it is placed when sterile the syringe the needles and the two bowls. Into one bowl is poured some methylated spirit and into the spirit is dropped the ampoule of adrenalin.

The pannikin is then taken out of the sterilizer and into it is put the contents of the three celluloid capsules and also 190 cubic centimeters of tap water. The pannikin is placed on a gas ring and the contents brought to the boiling point and boiled for 5 minutes. This solution is then poured into the empty sterile bowl on the table. The water used in the sterilization of the syringe and vessels must be free from alkali or the potency of the novocain will be destroyed. Tap water here in Wellington is perfectly satisfactory.



for the preparation of the solution and probably would be so in most places. To complete the furnishing of the table about a dozen small sterile swabs and two sterile guard are required.

The anesthetist now sterilizes his hands and dons a sterile gown.

The patient who has half an hour before been given a hypodermic injection of $1/300$ grain of hyoscin and $1/6$ grain of morphine is now placed on the table and the lower abdomen is exposed. The skin is prepared by being scrubbed freely with spirit from the umbilicus to the base of the penis and laterally to the flanks. Care must be taken to prevent the spirit from coming in contact with the scrotal skin. It is better to do the injections before the skin receives its preparation with iodine or mercurochrome. The skin having been prepared the two sterile guards are placed in position, one above with its lower edge at the level of the umbilicus and one below with its upper edge at the level of the base of the penis.

The capsule of adrenalin is carefully dried broken and its contents added to the novocain solution which should by now be cool. The syringe is fitted together and the stylets are withdrawn from the needles. A small quantity of the solution is drawn into the syringe and some is expelled through each needle to remove any rust or grease that might remain in the bore. It is advisable at this stage to remove the bowl of spirit lest it be inadvertently mistaken for that containing novocain.

The syringe is filled with solution and the small 20 millimeter intradermal needle fitted. The patient is warned that he will feel a few slight pricks but that he will receive warning of each. It is best to adopt some verbal formula of warning such as "You will feel a prick—now" the word now immediately preceding the insertion of the needle. In this way the confidence of the patient is retained. Four intradermal wheals are required two 1 inch above the upper edge of the os pubis and each 1 inch lateral to the midline and two 2 inches higher up and each 1 inch lateral to the midline of the abdomen. The method of raising a wheal is to insert the needle attached to the syringe into the substance of the skin and to inject a small quantity of fluid. The angle of incidence of the needle should be 30 degrees from the plane of the skin and the insertion should be made smartly. The correct placing of the fluid results in a definite white wheal and this must be obtained in order to provide a painless entrance for the larger needles.

Having raised the four wheals the anesthetist takes the 50 millimeter needle and attaches it to the full syringe. It is inserted through each upper wheal in turn perpendicularly to the plane of the skin. The needle is pushed on in this direction until it meets with a resistance which is the anterior layer of the sheath of the rectus abdominus muscle. This is pierced by a smart onward push of the needle which piercing is always felt as a prick by the patient. The needle point now lies in the substance of the muscle near its outer border and is pushed on gently until the resistance of the posterior layer of the sheath is felt. Here an injection of 3 cubic centimeters of fluid is made and 2 cubic centimeters more are injected as the point is withdrawn through the muscle. This should ensure that the fluid is placed toward the posterior part of the sheath near its outer border and aims to block the nerves to the muscle before they send off their anterior divisions. When the needle point is withdrawn from the anterior layer of the sheath

its direction is changed first upward and then downward so as to penetrate the sheath first an inch above and then an inch below the original sight of puncture and the solution is deposited as before 5 cubic centimeters on the posterior sheath and 5 cubic centimeters as the point is withdrawn through the muscle.

The whole process is then repeated through the two lower wheels. The downward injections through the lower wheels are made with 10 cubic centimeters of solution and particular care is taken to bathe thoroughly with fluid the anterior and superior surfaces of the os pubis in the region of the insertion of the rectus muscles. The last 2 cubic centimeters of the fluid in the syringe is injected as the needle is withdrawn slowly so that some may be certain of reaching each layer of the fascia. The 8 millimeter needle is now attached to the full syringe and inserted through each lower wheel in turn downward and inward in the direction of the os pubis. Contact with this bone is sought. The needle is then partly withdrawn and its direction changed slightly and reinserted the aim being to allow the point to pass close to the posterior surface of the bone and thus enter the space of Retzius. The point is pushed about 20 millimeters into the space and aspiration is made with the syringe in order to satisfy the operator that the point is not lying in the lumen of any blood vessel. With this assurance an injection of 5 cubic centimeters of fluid is made on each side.

The long needle attached to a full syringe is inserted through each upper wheel in turn and is directed downward immediately beneath the skin toward the lower wheel on the same side and a subcutaneous injection is made as the needle advances. Likewise through the upper wheels a subcutaneous injection is made upward and inward that from each side meeting at a point about 2 inches below the umbilicus in the midline. And similarly through the lower wheels the subcutaneous injection is carried downward and inward to a point at the upper part of the base of the penis in the midline. Thus the area of operation is now completely encircled by subcutaneous infiltration the rectus muscles on either side are infiltrated and the anterior surface of the bladder is bathed with fluid from the injection into the space of Retzius.

The amount of fluid used is as follows. On each side 35 cubic centimeters for the intramuscular injection 5 cubic centimeters for the space of Retzius 30 cubic centimeters for subcutaneous injection—that is 140 cubic centimeters altogether.

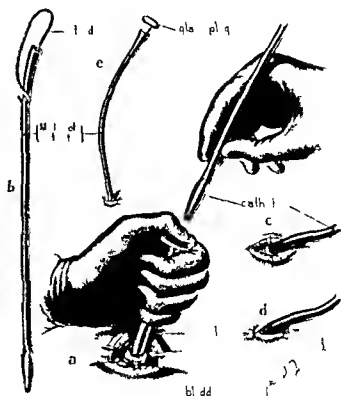


FIG. 1. a Shows thumb held over opening of cannula catheter about to be inserted. b Malacot catheter with intraluer. c sheath of recti muscle brought together above and below catheter. d skin closure. e catheter in place with glass plug in end.

The solution made as directed is of $\frac{1}{2}$ per cent strength so that the total amount of novocain given is 0.7 gram or about one half the maximum dose for the average adult. After 5 minutes the sensibility of the skin along the proposed incision is tested with a needle. If still sensitive a subcutaneous injection is made along the incision line. The anesthetist's duties are now complete except to reassure the patient from time to time.

THE OPERATION

The urethra is anesthetized with $\frac{1}{2}$ per cent solution of cocaine and soda bicarbonate after the method of Canny Ryll.

If a catheter can be passed the bladder is washed out thoroughly with 120,000 oxycyanide of mercury in the ward and it is again washed out and filled with the solution when the patient is on the table. If no catheter can be passed the patient is asked to hold the urine for 3 hours before the operation. If he cannot do this and no catheter can be passed to fill the bladder the following operation is contra indicated as a full bladder of reasonable capacity is essential.

The guards being placed an incision of 1 inch is made one finger's breadth above the upper

margin of the symphysis pubis transversely its center point being exactly in the middle line. The incision is deepened by a knife or sharp pointed scissors as far as the fascia of Scarpa. With a headlight a strong beam of light is thrown into the wound. The fascia of Scarpa is picked up with artery forceps and cut through and the anterior sheath of the rectum is exposed. Thin bladed retractors are then applied to draw the margins of the incision upward and downward and the aponeurosis is divided in a vertical direction. The retractors are then taken out and replaced thus serving to withdraw the edges of the aponeurosis laterally. The space between the two rectal muscles is sought by means of the handle of the scalpel and the muscles are separated. If the pyramidalis muscles are present they have their own separate sheaths and a little sharp dissection will be necessary to reach the layer of the rectal muscles themselves. These are separated down to the transversalis fascia. The retractors are withdrawn and the index finger of the right hand is passed down and pushed through the transversalis and the subjacent layers of fascia and is then drawn upward pulling the extravascular fat out of the way and with it the peritoneum which is reflected from the bladder to expose the latter below. As the finger is withdrawn the peritoneal fold and the other tissues in the neighborhood bulge downward and it is necessary to employ a third retractor to hold these out of the way. At this stage three retractors are used one on either side passing down beyond the rectus muscle and including the transversalis and the underlying layers of fascia on either side and one retracting upward the peritoneal fold and the other tissues. Swabs on holders are used to clear the field of any oozing and of the novocain solution which has been injected. By the aid of the headlight a beautiful view is thus given of an area of bladder about centimeters in diameter lying at the bottom of the wound. As much care as possible should be used not to press downward on the bladder itself as such pressure is the only thing that is likely to cause the patient discomfort.

The 10 cubic centimeter record syringe is half filled with the novocain solution—a per cent preferably. A needle is inserted into the midst of the muscular wall of the bladder and the solution is infiltrated up and down for about half an inch. It is then passed a little deeper until approximately just outside the mucosa when more solution is injected. The needle is then passed

right through the plunger being pressed forward as it goes to avoid injury to the intestines should any mistake have been made in the identification of the structure.

After what is supposed to be the wall of the bladder has been penetrated the piston is withdrawn. Clear bladder solution then wells up and fills the syringe thus insuring perfect safety in the next stage. The cannula armed with the trocar is plunged boldly through the wall of the bladder a spot being selected between two of the transverse veins which are usually conspicuous on the surface of the organ. The trocar is withdrawn and the finger is placed on the end of the cannula to prevent the rush of fluid from the bladder. A Malacot catheter (size 4 to 8 F) extended on its introducer is then passed through the cannula. It is easy to feel when the end of it emerges. The catheter is released from its holder the cannula drawn out over it and the catheter left in the bladder. After a few ounces of the fluid have escaped into a kidney basin a glass plug is inserted at the end of the catheter. Care should be taken at all times not to contaminate the operating field. When inspection shows that the catheter lies snugly in the bladder the catheter is pulled gently upward until the expansion at the end engages on the anterior bladder wall. Any fluid that has escaped around it is sucked out with the usual suction apparatus. All retractors are withdrawn the aponeurosis picked up with two chromic gut No. sutures and two silkworm gut sutures are taken through the skin one on either side of the tube. The long ends of one of these sutures are tied around the tube itself but no suture should penetrate the tube.

If there has been little oozing a strip of rubber dam is passed down to the surface of the bladder wall. The bladder is then emptied through the catheter a split binder applied and the patient returned to the ward.

The whole procedure should not take more than 5 to 10 minutes and the general state of the patient is not disturbed in the least.

AFTER TREATMENT

A drainage tube is applied as soon as the patient returns to the ward so as to keep the bladder empty until some consolidation has taken place in the wound. After a couple of days the catheter is corked and the patient is allowed to get about. The cork is removed every hour or two to let the urine escape.

THE IMPORTANCE OF PERITONIZATION IN ABDOMINAL SURGERY¹

JOHN I. CANNADAY, M.D. CHARLSTON, WEST VIRGINIA

ADHESIONS are among the curses of abdominal surgery. The disturbances caused by them are many and varied. Numerous operations successful and otherwise are undertaken for their relief. At times the patient gets reduced to what Joseph Price termed surgical junk. Many adhesions are no doubt the result of faulty surgical technique. It is in the interests of prophylaxis that I am presenting a few ideas which have been gathered from various sources.

In the removal of a tubo-ovarian abscess large raw areas frequently result from the separating of the pathological tissues from the pelvic floor and walls. At times it is difficult to cover these large areas with tissues that will graciously submit to the insult. If these surfaces are left unprotected there is always a strong possibility that a loop of small bowel will become adherent and result in mechanical obstruction. The peristaltic wave of the small bowel is so feeble comparatively speaking as to be unable to force the fecal current by adhesions that would interfere little if any with the function of the large bowel. Hence it is occasionally at least necessary to make use of some portion of the large bowel for instance the rectosigmoid to cover in and fully protect some vulnerable spot. The appendices epiploicae of the rectosigmoid act at times as a supernumerary omentum and have great protecting power. The omentum is fortunately in many instances abundant and mobile and can take care of much damaged peritoneum.

As a basic principle I desire to emphasize the importance of a careful and thorough scheme of protection for all denuded areas—unburied suture lines etc.

Coffey has devoted much time and energy to the working out of an elaborate and well nigh perfect technique for the building up of pelvic cofferdams and the absolute walling off of necessary lower abdominal drains. He has stressed the well known fact that if a drain or other foreign body comes in contact with a loop of small bowel it spells serious trouble.

In regard to some of the commonplace operations pertaining to abdominal surgery, I feel that it is of paramount importance that the surgeon take the time and pains to do a thorough and complete peritonization after the operation for removal of the gall bladder. Usually of course the edge of the liver can be readily drawn

out through the incision and the under surface fully well exposed. A fine plain catgut suture is passed first through the peritoneum just below the end of the amputated stump of the cystic duct. This running suture is carried back and forth closing in the edges of the peritoneum over the raw surface up to the anterior edge of the liver. The bite of the needle must be shallow so as to avoid injury to the bile ducts. When the suturing is complete of course the concavity under the liver is considerably increased but no raw surface is left. This thorough peritonization at least in part does away with some of the reasons advanced for drainage after removal of the gall bladder as the peritonization quickly seals over the under surface of the liver and tends to stop any oozing of bile that might take place from the raw surface. Occasionally one may encounter a case in which it seems difficult or impossible to make the under surface of the liver accessible. In such a case one may be able to protect the under surface to some extent with tabs of omentum and partially obviate the dangers of formation of adhesions between the duodenum and the under surface of the liver.

After the removal of the appendix the usual practice is to cover over the stump. However I know of a few surgeons who merely tie amputate and drop the appendix stump back into the abdominal cavity. I believe that the little time spent in covering over the stump also the stump of the meso-appendix is well spent as it may lessen the danger of formation of adhesions between the terminal portion of the small bowel and the caecum. I have often observed the extreme care taken in the clinic at St. Mary's Hospital Rochester Minnesota in peritonizing the appendix and meso-appendix stump.

It is following pelvic operations that there is probably the greatest danger of intestinal obstruction. After operations for the relief of suppurative appendicitis, caesarean section, myomectomy, hysterectomy, salpingectomy, removal of adherent fibroid tumors the dangers of obstruction certainly are to be considered. After making use of what parietal peritoneum is available one can often protect and cover any remaining raw areas by making use of the rectosigmoid fold. Rarely in case of densely adherent ovarian cysts of considerable size I have practiced marsupialization and have found that these cysts treated in such manner

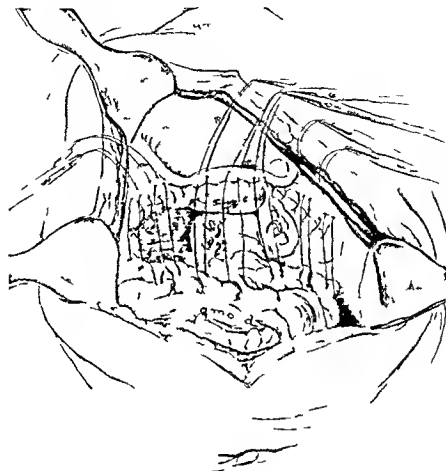


Fig. 3. Uterine and
tubal

and iliac ligament



Fig. 4. The
ligament

ligament and

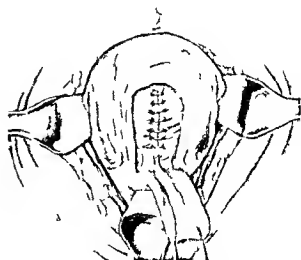


Fig. 5. The method of
ligament



Fig 2 The method of covering the amyl uterine duct and raw surface left after cholecystectomy



Fig 3 Technique of closing cholecystectomy area

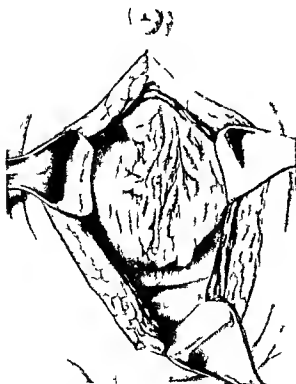


Fig 6 Technique of covering uterine suture line by use of omentum

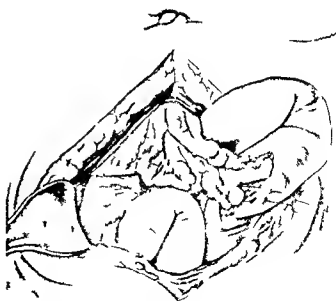


Fig 7 The repair of damaged intestinal peritoneum with omentum

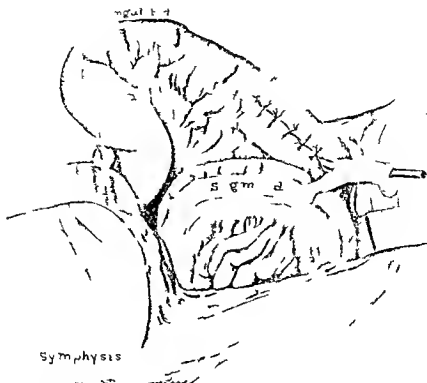


FIG. 8. The position of the sigmoid by the uterus and the peritoneum.

usually fill in by granulation from the bottom and give no trouble afterward.

After the performance of cesarean section through the fundus of the uterus I believe that it is a wise precaution to protect the suture line with omentum. Ordinarily in performance of this operation I make an anterior low incision in the body of the uterus and protect it by use of a flap of peritoneum as shown in the illustration taken from the work of Titus.

If as a result of the performance of enterostomy in the small bowel a loop becomes adherent to the parietal peritoneum later attacks of complete or partial obstruction are likely to result. This complication can usually be prevented by tucking a bit of omentum about the enterostomy tube a procedure which not only aids early closure but prevents the formation of crippling adhesions in that locality the omentum serving as a buffer. When omentum is not available one or more appendices epiploicae from the sigmoid make a satisfactory substitute.

After the various types of intra abdominal bowel operation omentum is available if needed to reinforce the suture line. In the performance

of operative procedures involving the anterior stomach wall gastrocolic omentum is available when reinforcing material is needed.

Relative to the general subject of adhesions and the importance of peritonitis in the prevention of vicious adhesions I occasionally see surgeons rather recklessly breaking up adhesions in the abdomen. At such times it usually occurs to me that when healing again takes place the number of adhesions will likely be multiplied by two.

A blood clot remaining in the peritoneal cavity doubtless often acts as a foreign body becomes organized and results in the formation of adhesions.

In times past we have occasionally heard of some surgeon who made use of various substances in the abdomen with the idea of preventing adhesions. I recall two such substances vaseline and mineral oil. Of course both would act as foreign bodies and cause rather than prevent adhesions a matter of physiology rather than of mechanics. The same physiologic principles obtain concerning the use of Cargile membrane which I believe is the chemicized peritoneum of the ox.

This was used considerably some years ago. Most of us know from observation however how the peritoneum reacts to a foreign body and there is certainly no reason why this particular material should be innocuous. Fortunately such methods seem to have about fallen into disuse. Repair material from the patient's own structures has been proved to be the best and fortunately is generally available.

No originality is claimed for any of these

methods. They have been gathered from various sources and have proved satisfactory by prolonged clinical try out. In more than one thousand consecutive abdominal sections which have been handled in accordance with the methods outlined neither myself nor my surgical associate Dr. Bankhead Banks in our work in the Charleston General and Salvation Army Hospitals have had any case which has been followed by intestinal obstruction.

A CASE OF SUCCESSFUL END-TO-END SUTURE OF THE PANCREAS

ALAN NEWTON M.S. (M.B.) F.R.C.S. (G) F.A.C.S. F.R.S.A. M.L.D. L.R.E. M.T. ALMA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

THE purpose of this paper is to report a case of successful end to end suture of a pancreas completely torn across through the neck with out damage to other viscera by a crushing injury to the abdominal

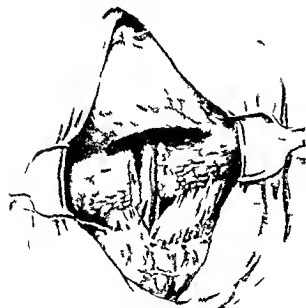
Such uncomplicated injuries of the pancreas are rare because of the protected position of the gland. P. Dolc lower has recently reported a series of 15 cases of abdominal contusions in 83 of which there were associated lesions of abdominal viscera the pancreas being involved in 1 case only i.e. 1 percent.

These injuries to the pancreas are difficult to diagnose so that it is not unusual for operation to be delayed so long that secondary inflammation and complications due to the escape of pancreatic fluid are present. These are in slight injury effusion of serosanguineous fluid into the lesser sac with patches of fat necrosis and in the more severe injuries necrosis of the pancreas itself with hemorrhage fat necrosis and peri-

tonitis (I've). The importance of operation even in late cases has been emphasized by Mikulicz who has reported 4 cases of subcutaneous injury to the pancreas. Of the 13 were not operated upon and all of the patients died while of 11 operated upon 7 recovered. He points out that slight contusions often result from injury but either heal spontaneously or give rise to minor disturbances. The relation of trauma to pseudo cysts of the pancreas is of course common knowledge. The postoperative death rate on the cases reported by Mikulicz might have been lowered had operation been performed earlier. In some of the cases however the delay was due doubtless to difficulty in diagnosis.

In incomplete lacerations it is generally agreed that suture of the gland is indicated to prevent further leakage of the secretion but there is some difference of opinion as to the best operative measures to adopt when a complete division of the pancreas is found. Walton states that any attempt to bring about an end to end suture in such cases will almost certainly fail for it is very unlikely that the ends of so minute a duct will be accurately approximated. The general experience is that the tissues will show extensive sloughing at the site of anastomosis and that the case will terminate fatally. Walton suggests the complete removal of the separated body and tail and careful suture of the divided stump of the neck.

Finney on the other hand has reported the successful removal of a cystadenoma of the pancreas which involved the whole middle portion of the gland approximately two thirds of which was replaced by the tumor. The greater part of the body of the pancreas was removed with the tumor and the head and tail of the gland were then united as accurately as possible by mattress sutures. A fistula developed at the site of the cigarette drain which was used to surround the anastomosis but this closed in 3 months. Finney mentions that Garre in 1903 reported a successful case of suture of a pancreas which had been torn in two as a result of direct violence. The cases and the one reported in this paper suggest that Walton is unduly pessimistic about the results of end to end suture of the pancreas. As Link has stated it would appear that the danger of extensive operations on the pancreas has been



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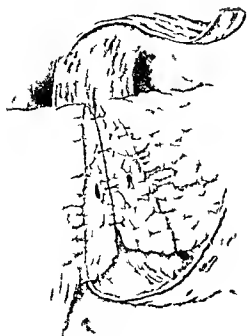


Fig. 2 The omental flap is placed behind the pancreas and the posterior borders of the torn surfaces are united by suture

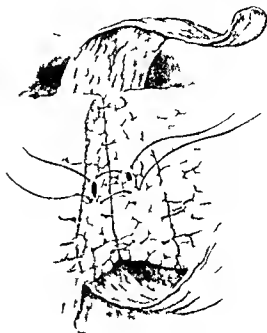


Fig. 3 Suture is introduced in the region of the duct

exaggerated and that it is unnecessary to perform operations upon this organ in a spirit of desperation. The history of my case is as follows:

Case 1. A farmer 30 years of age was admitted to the Melbourne Hospital on August 13, 1914. He stated that 4 hours before admission he had been leaning over a fence when a pet pony, which he had trained to do various tricks, suddenly jumped up behind him and planted his forefeet in the middle of his back, thrusting him violently against the fence. Soon afterward he experienced upper abdominal pain which gradually increased in severity and then became generalized over the abdomen radiating to the left shoulder region. He had vomited twice since the onset of the pain.

His temperature was 99 degrees, pulse 88 and respiration 25. His tongue was dirty but not dry. Examination of the heart, lungs and urine revealed nothing abnormal. The abdominal wall was rigid and there was generalized tenderness, more marked in the upper abdomen. There was no evidence of free fluid in the abdominal cavity and the liver dullness was not diminished. A diagnosis of ruptured abdominal viscus was made and immediate operation advised.

Operation. An upper abdominal incision was made through the right rectus muscle just lateral to the midline. As soon as the peritoneal cavity was opened a small amount of blood escaped, but no lesion of any of the organs in the greater sac was found. There was some subperitoneal hemorrhage near the duodenojejunal flexure. The lesser sac was then opened through the gastrocolic ligament and a complete division of the pancreas through the neck was discovered. The lesser sac contained blood and there were two patches of fat necrosis near the foramen of Winslow. There was also some retroperitoneal hemorrhage. The aorta was visible dorsal to the tear in the gland, but the splenic vein was not seen (Figs. 1, 2).

A repair was effected as follows: A strip of omentum was fastened about 2 inches in width and of sufficient length to encircle the pancreas. This was placed behind the tear and the posterior edge of the gland sutured with chromic gut (Figs. 2, 3). Two similar sutures were then placed in the continuity of the duct, which could not be identified (Figs. 3, 4). The anterior surface of the pancreas was similarly sutured.

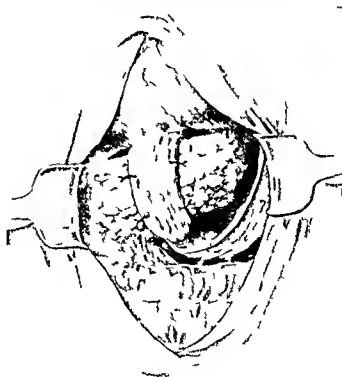


Fig. 4 The omental flap encircling the end-to-end suture line in the pancreas

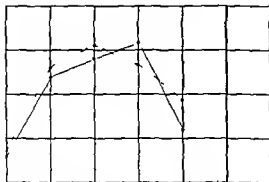


Fig 5 Results fth glu os t l a et st m de a d
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RELIFPLVCES

- 1 E r S F lan t o
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A RAPIDLY CURATIVE OPERATION FOR IRRITABLE ULCER OF THE MALLEOLUS

WITH AN ACCOUNT OF THE DISEASE

C I CORLETT M.D. CH.M. (Syd.) F.C.S. A SYDNEY AUSTRALIA

C. It. g. S. g. t. th. Syd. y. ll. p. al.

THE disease described as irritable ulcer of the malleolus (though it is not invariably situated over a malleolus) is not very uncommon among the poorer class of people and it occurs though more rarely among those higher in the social scale. I suspect however that it is often seen without being recognized for what it is. This is not altogether to be wondered at when so many writers of textbooks have failed to mention it. This is particularly true of dermatological textbooks and dermatologists. Some surgical textbooks mention it some do not. But I fear that many observers pass it by as a mere ulcer certainly a painful one but just an ulcer a mean thing.

It is more than this. It is a very distinct clinical entity and it is certain that it has an equally distinct underlying pathology. It is worth attention it is worth curing and it can be cured simply rapidly and certainly.

I contributed a paper embodying a ten year clinical study of this disease to the *Medical Journal of Australia* in 1927 when I traced the history of a series of cases each one over a period of several years. In the same paper I recorded the results obtained by a curative operation which I had devised. Since then I have added to the number. In my own series there have been 18 patients with 27 ulcers. 4 of these were operated on and three of my hospital colleagues have done one each. There have therefore been 27 operations on 21 patients with 30 ulcers.

In the ordinary run of cases the ulcer is quite small perhaps only a little thing a quarter of an inch in diameter. I never saw what I would call an extremely large one until after the publication of my first paper and then I found that sometimes these ulcers did in time reach a considerable size.

In the great majority the ulcer is situated on or just above one of the malleoli (Figs 1 and 2) and when there are two one may be situated on each limb perhaps at the lateral malleolus on the right side and at the medial malleolus on the left. Occasionally one may find the lesion in

front of the lower part of the leg and in one of my patients in the present series there was a large one on the dorsal aspect of the foot. In two others who had irritable ulcers on one or other of the malleoli I have seen painful spots not developed into ulcers on the dorsum of the foot. Closer examination will often show that beyond and below the ulcer there are signs of malnutrition of the skin a chronic congestion with tendency to slight stippled cicatrization and there are sometimes little heaped up spots or patches of crusted epithelium some of them very tender to touch. When these come off there may be left a tiny pit in the skin which is tender when probed. The ulcer is nearly always at the proximal portion of the area. If the ulcer be gently probed one finds one or two spots of acute tenderness on the proximal margin of the ulcer or the whole of the proximal margin may be tender. I have seen tender spots on the floor of the ulcer but in my experience the tenderness is usually at the proximal margin. One gets the idea from the textbooks that the general surface of the ulcer is exquisitely tender. In very small ulcers it may be difficult to be sure about the location of the tenderness but in the larger ones it is certainly placed where I have described it. The margins of the ulcer are usually steep but not invariably and there is usually some oedema at the margins. Small ulcers may have a punched out appearance. The limb usually shows evidence of poor circulatory efficiency. There may be varicose veins of the usual variety but the type of leg showing numerous dilated purplish venules seems to be the one most prone to suffer. I have had three cases in which it could not be said that varicose veins were present.

The symptom chiefly complained of is pain. It is worse at night and especially after walking or standing. The pain is of a shooting character it is often very severe making the patient's life one of prolonged suffering interfering with sleep and producing a state of chronic invalidism. The pain bears no relation to the size of the ulcer and in some cases there has been pain at the site for months before the ulcer has formed. In other cases the ulcer occurs as soon as the



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pain. Some of the patients have given a history of a blow on the spot antecedent to the onset of the symptoms. I think that occasionally the disease may supervene on an actual wound or abrasion or form in connection with a pre-existing ulcer which has not been particularly tender or painful. Something very like these ulcers so far as pain and obstinacy is concerned is met with at the anus constituting the disease usually known as fissure.

There is undoubtedly a predisposition in some people to the occurrence of these lesions as is shown by the existence of two ulcers at the same time or the outbreak of a second or third one months or years after the first. One of my patients has had four one on each malleolus within the past 10 years. The first occurred before I had begun to employ the operation; it persisted for a couple of years and finally healed. The second I operated on in 1917, the third in 1921 and the fourth in 1927. Each operation was immediately curative and there has been no local recurrence.

The lesions are extraordinarily resistant to the kind of treatment usually applied to ulcers. When irritable ulcers are specifically mentioned in textbooks one finds that the reader is advised to employ among other utilities various caustic applications such as pure silver nitrate. The pain caused by caustic applications is agonizing though it is true that sometimes after recovery from the initial pain of the application there is

an amelioration for some days. But after this it is as bad as ever. The disease goes on.

But if the ulcers are extraordinarily resistant to traditional treatment I have found that they are nevertheless extraordinarily amenable to treatment by a simple little operation by which the pain is immediately removed and the ulcer in all ordinary cases healed in a few days. There has been one partial failure among all the many ulcers operated on and the partial failure has been made successful by a second operation. The case is described beyond.

TECHNIQUE OF THE OPERATION

In order to get the part as clean as possible before the operation it is desirable that the patient should be kept in bed with the limb elevated for a couple of days or longer if necessary and I have been accustomed to have hot fomentation applied. But I have seen this overdone with the production of scalding. Such zeal should be avoided. I have also used applications of Dakin's solution or the like. In such cases the dressing should be changed frequently.

Local anesthesia is used. The patient should be given a hypodermic injection of morphine 4 grain (15 milligrams) and of hyoscine 1/100 grain (0.6 milligram) an hour before the time of operation. This is not absolutely necessary but it is advantageous and I strongly recommend it. The local anesthetic is a solution of novocain of 0.5 per cent strength in water containing adre-

 Γ_1 3

11 3 Irritable ulcer Ca c Series Mrs B V r
large ulcer on dorsum of left foot (with two small ones
higher up) Duration of large ulcer 23 years Healed in 6
weeks after operation (Compare Fig 5)



1164

Fig. 4. Irritable ulcer. Case 2. Series 2. Mr. B. 17 yr.
ulcer over lateral malleolus of right limb. Duration 2 years.
Healed in 4 weeks after operation. (Compare Fig. 5.)



135

Fig. 1 Irritable ulcer (a) and (b) showing
an inflammatory cell infiltrate within the ulcer
ulcer shell.



14

[illegible]

nalin 1:50,000. It is better not to use cocaine though in my earlier cases I used it employing a 10 per cent solution. Infiltrate liberally the tissues above beneath and on either side of the diseased area from the skin to the periosteum. About 30 mls (one fluid ounce) of the solution will be amply sufficient. The leg is elevated. When the part has become pale under the action of the adrenalin a tenotomy knife is carefully introduced in healthy tissue at one or more points above the ulcer and is so manipulated that it severs all the tissue from immediately beneath the skin as far as the periosteum. The object being to cut the nerve supply. The knife is usually made to slant somewhat toward the ulcer as it cuts so as to undermine toward the edge but I do not cut so far as to separate the ulcer from its deeper attachment for this might cause sloughing. The shape of the subcutaneous incision is more or less like an inverted V and particular care is taken not to make a cut right down to the bone at the apex of the V. At the knife enters and leaves. But the care is to be where one cannot cut right down to the bone. The posterior cut at the posterior end of the ulcer is always be made deeper than the anterior cut at the distal end. In one of our cases the ulcer was large and on the anterior surface the extensor tendon. The tendon was cut by our deepening the incision at the anterior edges the knee was flexed and the ulcer was cut in three places. The incision was made in the simple manner and the result was a good one. If there is a large ulcer the ulcer is

excise a transverse vein under local anaesthesia much easier than it is under ether. To do this infiltrate a transverse line above involving the whole thickness of the subcutaneous tissue as far as the sheath of the umbilicus and with a large needle infiltrate on either side of the vein.

The dressing need not be removed for a week and at the end of that time, in cases of the ordinary small size, the ulcer will be found healed. This rapid healing occurs even in ulcers that have defied treatment for years. In the two patients with large ulcers to be described hereafter, it will be seen that in the first the ulcer healed in less than 3 weeks and in the second patient, with two ulcer openings, in 4 weeks and 6 weeks respectively. The pain disappears on the instant

The result is to tempt the Negro nation in our cry for greater relief or more certain result. It is a luring, and an expectation to say a man of about here said, that it is like a miracle that relief is given so complete and unsolicited.

[illegible]



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than I had ever seen or expected to see as well as several others of the more usual kind. It will be of interest to record here something about the large ulcers. I add reports of the smaller ones as more typical examples.

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I had an analogous case in my first series. There was one patient (Case o) a man who had irritable ulcers over the medial malleolus of each leg operated on in March 192. Two and a half years later he developed a third irritable ulcer below the medial malleolus on the right side beyond the site of the first one. This was operated on with disappearance of the pain and healing of the ulcer. Six months later he developed an abscess about this spot which broke and left an ulcer. This had the characteristics of an ordinary indolent ulcer without pain or tenderness. He

was unable to come into the hospital and I do not know his later history.

I look on these secondary ulcers as simple ulcers due to the poor nutrition of the area. It is obvious that even after healing in such a bad case as that of Mrs B the tissue must be of very third rate quality so far as its vitality is concerned and it is not surprising to find that it is liable to break down on relatively slight provocation. The clinical features of lancinating pain and tenderness of the proximal margin so characteristic of irritable ulcer will be no longer present and so far as my small experience of them goes Mrs B's being the only case I can judge by they do not resist the ordinary forms of treatment as do irritable ulcers.

However that is all the material of the kind. There have been no other cases of secondary ulceration and I have followed up most of my patients for many years.

I record next the rest of my recent cases. These illustrate the more usual type. They have been too recent for any follow up notes.

CASE 3 Series 2 Mrs M C aged 63 years was admitted to the Sydney Hospital on October 4 1927 with two small irritable ulcers of recent development both of them very small (1½ x 7/8). One was situated on the right lateral malleolus and the other over the left medial malleolus. They were very painful and tender. The edges were abrupt the bases soft and there was discoloration of the surrounding skin. Albuminuria was present. On October 6 both ulcers were operated on in the usual way. On the 14th the left one was healed. On the 20th the right one was healed and on that date she left the hospital.

CASE 4 Series 2 C L male aged 75 years was admitted to the Sydney Hospital on November 22 1927 with an irritable ulcer which had been present for 8 months. It was about a quarter of an inch in diameter and of considerable depth. There was some keratosis of the skin in the area surrounding the ulcer. Varicose veins were not visible. The operation was done on November 24 and he left the hospital on December 6 with the ulcer healed. This is the oldest patient I have seen with the disease.

CASE 5 Series 2 Mrs J B aged 45 years came to me on February 20 1928 with a small irritable ulcer over the left medial malleolus which she said had been present for 7 years. While always painful during the past 4 months it had been causing agonizing pain so bad that she had been unable to do any housework. I operated on her on February 22 and the ulcer was healed on March 3. She went home like the rest completely relieved of pain and with the ulcer healed.

CASE 5 Series 2 Mrs M W aged 47 years came on March 7 1928 with a small irritable ulcer over the left lateral malleolus which had been causing great pain for 6 years. She had a varicose vein above the ulcer ending at the upper part of the leg in a dilated plexus. The operation was done on March 9 and consisted in a subcutaneous section of the nerve supply and excision of the whole varicose vein including the plexus under local anesthesia. The pain disappeared forthwith and the ulcer healed in a



FIG. 8 Irritable ulcer. Case 4 Series 2 Mrs K. Ulcer of 5 years duration over right medial malleolus with surrounding area of congestion and fibrosis. Healed in 13 days after operation. The pigmented area here up the leg is on a site of an old ulcerated wound.

week but she was kept in the hospital another 2 weeks to ensure firm healing of the wound higher up.

CASE 6 Series 2 Mrs K aged 45 years came for treatment of an irritable ulcer over the right medial malleolus which she had suffered from for 8 years. She stated that 4 years of that time had been spent in bed trying to get relief. The ulcer had on several occasions seemed to heal or almost heal but without relief of the pain. The pain had for several years been incessant day and night the only variation being that at times it was worse than at other times. She complained rather sarcastically that she had been labeled by doctors as hysterical and as imagining the pain. How far that was true can be judged by the result of the operation. With most of us constant pain and sleepless nights would be likely to induce emotional states—prominently terror and despair. That certainly was her state of mind. She had little personal expectation after so many failures of a successful result following the operation suggested—but she was desperate.

The ulcer was about a third of an inch in diameter. The proximal margin was extremely tender but not the floor. It was surrounded by a dark livid area of congestion. The whole area was about 1½ inches in diameter it had become fibrotic and was firmly adherent to the bone beneath (FIG. 8). Here up on the leg was a large brown mark caused by a wound which had taken 3 or 4 weeks to heal. This had not been a painful lesion. There was a large varicose vein on the thigh but there were none below the knee.

I performed the little operation on May 28. From that moment she became entirely free from the pain which had tortured her day and night for so many years. A dressing of plain sterile gauze was applied and this was removed on June 4 revealing a firm scab over the site of the ulcer. Fomentations were applied to the area on June 9 to see if the scab would loosen and next morning June 10 the scab was off and the site of the ulcer was seen to be completely covered by a healthy looking layer of epithelium. It has remained healed. The pain has never returned.

However it is obvious that the resisting power of this area can be no more than that of any

similar matrix firmly adherent over a considerable area to a bony process in a situation peculiarly exposed to injury. A comparatively slight injury might cause a breakdown and an ulcer might easily form on the spot. But this would not be an irritable ulcer. It would be analogous to the relatively painless ulcers that are so common in persons with varicose veins. It would be like the recurrence noted above in connection with Mrs. B's case (Case 2) and it would heal quickly, as hers did with rest in bed. Mrs. K. has been warned quite frankly that this is possible, but she has been told too that if an ulcer forms again it will respond readily to treatment by rest and protection. It will not be an irritable ulcer.

It does not require much imagination to picture the state of mind of such a patient on finding herself suddenly rid of all her torment, mental and bodily, and I need not spend words here on that aspect of it. It is indeed like a miracle, as so many patients who have had the operation have put it.

I am deeply impressed by what I have seen. Who would not be? Here is something that is

not the old traditional futile tinkering. It does things. The patient gets well.

But I must emphasize the importance of proper diagnosis. The true irritable ulcer is not difficult to recognize and should be recognized. The treatment I have described is for a special kind of lesion only and not for all ulcers, not even for all painful ulcers. And it should be realized that the treatment does not give the patient a new leg. If varicose veins need treatment, that treatment should be given them.

SUMMARY

Irritable ulcer is a special entity characterized by intense pain and associated with acutely tender spots at the proximal margin. It is usually small and in the large majority of cases it is situated over or just above a malleolus. It is obstinately resistant to cure by the treatment recommended in textbooks. The pain can be removed immediately and the ulcer made to heal quickly by subcutaneous section of the nerve and all the tissues from the skin to the bone above and on either side of the painful area that includes the ulcer.

THE PREVENTION OF PERITONEAL ADHESIONS

GEORGE GELLHORN M D F A C S St LOUIS MISSOURI

From the Gyn of g cal S rv St M y H p i l

IT has repeatedly been asserted that it is impossible to prevent the formation of peritoneal adhesions following gynecological laparotomies. Such a view cannot be accepted unreservedly. It is true that there are predisposed individuals whose peritoneum is abnormally sensitive but their number is probably very small. It is also true that an operation performed during a more or less acute inflammation must needs leave adhesions behind, particularly if the wound has been drained.

In the great majority of our operations however we have to deal with so called "clean" cases and if in these there are later disturbances which may even call for another laparotomy we must admit to ourselves that there is something wrong with our technique. I am by no means speaking only of ileus. Such a serious sequel is fortunately not overly frequent. In most instances the patients complain for years of ill defined discomfort in the abdomen, more or less distinct pain in this or that place, a sense of pressure, pull or fullness, various gastric and intestinal symptoms, distress in walking or reduced capacity for work—and the *persistency* of such symptoms however slight each of them may be, undermines the joy of living and destroys the satisfaction over an otherwise successful operation.

The prophylaxis of adhesions has in the course of years brought forth a multitude of suggestions each of which promised to improve our results. It is not my intention to analyze these various methods as to their relative merits. Rather would I point out that not too much can be expected from any *single* procedure and that the *entire* operation must be guided by the thought of prophylaxis. The prevention of adhesions must be the *leit motif* of every step.

If for example the surgeon incises the skin painted with iodine or picric acid and enters his hand into the abdominal cavity without first washing off his gloves in saline solution, chemically irritating substances may be brought in contact with the sensitive peritoneum. The same possibility obtains if intestinal loops escape upon the abdominal skin which has not been covered with towels or if during the operation the hands are dipped in an antiseptic solution but not rinsed off with water.

The unprotected pressure of a self retaining abdominal speculum or the use of retractors with sharp pointed toothed or otherwise unsuited edges leads to mechanical irritations of the delicate peritoneum which in turn may cause adhesions.

The flooding of the abdominal cavity with an indifferent fluid such as saline solution quickly produces an inhibition and whitish discoloration of the peritoneum and constitutes a chemical damage. Too much and too energetic sponging on the part of a sedulous assistant however well meaning it may be is apt to be synonymous with rubbing and scratching of the peritoneum. Finally the closure of the peritoneum without eversion and broad adaptation of the cut edges is almost certain to lead to adhesions with the omentum.

All these etiological points are so self evident that I would hesitate to mention them were it not for the fact that one may see them ignored almost every day.

The prevention of adhesions is in truth a highly complicated procedure which however becomes a smooth and almost automatic performance by thousandfold repetition. Only those special methods which are readily incorporated in the general scheme of prophylaxis give any prospect of advancing us toward the solution of our problem.

This is true too of the following suggestions. I wish to emphasize in advance that they will *contribute* to the prevention of adhesions only if the entire plan of operation is influenced by the thought of prophylaxis.

The wadding off of the intestines with gauze packs or towels carries with it the possibility of future adhesions. If these packs are introduced dry they may rub the intestines or the latter may stick to them when they are removed at the end of the operation and in any case small defects of the serous surface are the result. If however they are used wet they cool the gut by evaporation and thus irritate the visceral peritoneum. It is necessary to realize that the peritoneum which is so highly resistant toward infections is very sensitive otherwise and vigorously reacts to chemical, mechanical or thermic stimuli.

For more than 15 years I have used for the packing away of the intestines only sheets of pure

rubber which are boiled with the instruments and kept in warm saline solution until needed. Such rubber sheets may be bought in any size. About two square feet suffice; the rubber itself should not be too thin. It is obvious that these rubber sheets are absolutely non-irritating as they are smooth and maintain the warmth of the gut. Therein lies the further advantage of preventing shock. Then too such a sheet unlike gauze packs is readily found and is not apt to be left inadvertently in the abdominal cavity. My procedure has been adopted by a number of operators (Curtis Crossen and others).

Quite a few years ago John G. Clark of Philadelphia suggested a copious enema at the end of the operation as thereby the kinked intestinal loops would be stretched out into normal position and prevented from adhering to each other or to the parietal peritoneum. I have adopted this method with the modification suggested by George Gray Ward of New York and proceed as follows: A soft rubber catheter is introduced into the rectum before the narcosis is started; it is clamped and left *in situ* during the operation. When at the end of the operation the peritoneum is being closed, an enema of from one to two quarts of warm glucose solution is given with the patient still in Trendelenburg position. One can see plainly how the collapsed intestinal loops fill and assume a more normal position. Here too the shock preventing effect is very impressive and adds to the value of the procedure.

If however one fears lest by this distention the intestines and omentum would be forced against the anterior abdominal wall and thus adhere even more readily, air or oxygen may be pumped into the peritoneal cavity so as to prevent the intimate contact between visceral and parietal peritoneum. I make use of this additional means in cases in which many adhesions have been encountered at operation.

The peritonealization of raw surfaces is now a days a self understood part of a good technique. In the thoroughness of this operative step there are however great individual differences. It is true that until recently a surgeon will leave behind uncovered ligament stumps yet smaller defects are often ignored. It is a very common observation that in operations for fixed retroflexion very little attention is given to the raw and denuded surface of the fundus uteri. This condition invites new adhesions and there can be no doubt that

adhesions between uterus and intestines or omentum cause more distressing symptoms than those between the intestinal loops alone.

This complication is prevented by a method which I described about 8 years ago¹ after having tested it for more than seven years. The uterus is pulled upward and toward the promontory by means of a tenaculum and the bladder peritoneum is incised as in a hysterectomy. The bladder peritoneum is then gently pushed downward with the finger as far as the cervix care being taken not to go beyond the uterus on either side. The bladder peritoneum thus forms a sort of apron which is sewed upon the posterior surface of the fundus the uterus having been pushed forward into an exaggerated anteversion. The sewing is done with a continuous suture of thin catgut which is inverted so as to hide the knots which may conceivably cause an adhesion of a neighboring intestinal loop.

As only bladder peritoneum but not the bladder itself is used for the covering of the fundus neither vesical symptoms nor difficulties in any future confinement need be anticipated as I can attest from large experience. Incidentally a normal position of the uterus is promoted.

It may be argued against all these refinements of technique that they consume too much time. In reality the operation is prolonged only so slightly that none but desperate cases should be excluded from the procedures discussed which add so materially to the final and permanent success of our operations.

SUMMARY

To sum up then we may say

1 The ultimate result of gynecological laparotomies is too often marred by postoperative adhesions.

A good technique in abdominal surgery must carefully avoid any chemical mechanical or other irritation of the sensitive peritoneum.

3 Special methods looking toward prevention of adhesions must be readily incorporated into the general plan of operation.

4 The author's method of using rubber sheets instead of gauze packs his method of covering raw surfaces upon the fundus and the method of Clark and Ward—proctoclysis—at the end of the operation if combined with an otherwise perfect technique have proved of signal value in preventing postoperative adhesions.

VARICOSE VEINS THE INJECTION VERSUS THE OPERATIVE TREATMENT¹

A STATISTICAL REPORT

H O MCPHEETERS M D F A C S MINNEAPOLIS MINNESOTA

THE history of the injection treatment of varicose veins dates from the invention in 1854 of the Pravaz syringe. Much experimenting was done and many complications arose as the method was developed. The modern era of this method dates from 1911 when Professor P. Linser of (6) the great Tübingen skin clinic noticed that the veins gradually became sclerosed after the intravenous use of bichloride of mercury in the treatment of syphilis. He then applied the idea in the treatment of the varicose veins and obtained very good results. At his clinic they used various solutions and finally adopted a 20 per cent sodium chloride solution as the best. Coincident with this Professor Sicard (10) of Paris noticed the same thing in the luargol treatment of syphilis. He adapted the idea to the varicose veins and used a sodium carbonate solution but later the sodium salicylate in 20, 30 and 40 per cent strengths. This has continued to be the solution preferred in his clinic to the present time.

For the past 3 years the author has used the injection treatment of varicose veins in preference to the operative treatment. Due to the theoretical danger of pulmonary emboli and to the fact that fatalities have occurred from this cause a collection of statistics from a large number of surgeons located in all sections of the country employing all types of operations has been made in order to compare the efficacy of the two methods.

Under the subject of varicose veins we must consider any abnormal and unusual enlargement of the veins of the body regardless of the cause or location. In the ordinary literature however when speaking of varicose veins we mean the varices which occur on the lower extremities. It is with these that I wish to treat in this paper.

A complete discussion of the etiology of varices of the lower extremities would fill many pages. Many men have written on this phase of the question and each has his own ideas. The most prominent of the theories and those having the greatest weight of evidence behind them seem to bear out the idea that the patient has a congenitally weakened vein wall. Secondarily to this a phlebitis develops with a further weakening of

the vein wall. This phlebitis is of a very low grade and usually symptomless. The extremely weakened vein wall then gives way, dilates and elongates itself producing the typical varicose vein. Occupational stris, pregnancy, pelvic tumors, glandular changes and so on, no doubt have their influence.

The pathological changes occurring in the vein wall are mostly those of an inflammatory process. This phase is covered most thoroughly by Nicholson, Berstein, Lehman and Fischer.

I wish to emphasize here that the flow of blood in the varices, particularly the larger ones, is practically stationary or reversed. Thus the blood flows down through the superficial saphenous vein through the communicating veins to the deep system where it is forced back up into the femoral veins, part of which must drop back again through the saphenofemoral opening with its deficient protective valves into the superficial saphenous vein. This is covered thoroughly by Berstein in his discussion on the Trendelenburg tests.

Any treatment for this condition must attempt to obliterate the dilated varices with their reverse flow. The blood is then diverted through the normal superficial veins and the deep system.

The earliest mode of treatment was the surgical excision and this is still advocated by many surgeons of the present day. The operative treatment however has been unsuccessful in such a large percentage of cases and the mortality has been so high combined with postoperative disability, hospitalization and complications that it has been discarded by many of the best surgeons. The Schede operation was the one used most often for years and was the most radical. The scars from this operation were very disfiguring and unsightly. When done thoroughly, however, it gave the most permanent relief. The Babcock operation and later the Mayo modification of it were satisfactory in many cases. These however did not care for the collateral veins and the percentage of recurrences was high.

A very thorough discussion of this phase of the subject is given in the Johns Hopkins bulletin for 1905 in a report by Robert T. Miller, Jr. He shows by the gross specimen how the veins have

reformed and how the cut ends of a vein as in the Schede type will often anastomose across the scar with a reformation of the varix. This I have often seen. I am positive that the percentage of recurrences even after the most thorough operation is far greater than any of us have supposed.

Operative work should not be undertaken in the face of infection of the leg as is done in the case of extensive ulcerations. In these cases the patient should be kept in bed from 1 to 3 weeks preparatory to the operation in the attempt to bring the infection entirely under control. Due to the extensive resection with its consequent trauma the incidence of infected wounds in the Schede type of operation was high and oftentimes the whole wound would slough open.

Thus it is apparent that any mode of treatment which avoids complications and oftentimes poor end results both functional and cosmetic and at the same time saves the patient the long period of hospitalization entailed by the operative work is most certainly a great step forward in the care and treatment of this condition. This advance has been made in the treatment of the varices by the use of sclerosing solutions or the so called injection treatment.

The injection treatment is based on the assumption that a thorough injury of the intimal lining will cause a thrombus to form. Through the process of organization of this thrombus a complete obliteration of the vein will develop with a positive and permanent result. If the intima is not injured sufficiently there may be a regeneration of the intimal cells with the normal smooth vessel lining and thus a regeneration of the vein or in other words a recurrence of the varicose veins. When considered in comparison with the operative method the injection treatment is far superior.

In every case there is a theoretical possibility of emboli developing and proving fatal. To one who does not realize that there is a reverse flow in varicose veins it is most certainly logical to expect the thrombus intentionally developed in the veins to break loose and give a pulmonary embolus. Clinically however this has happened so rarely that it no longer causes us any concern. The development of sloughs and phlebitis is the result of technical errors and can be entirely avoided.

There need be no failure to obtain a perfect result with the injection method if it is continued until all the veins have been obliterated. On the other hand if the solution is not brought into

contact with the intima of the vein in such concentration as to cause a cloudy swelling of the intimal cells with their later sloughing away redevelopment of the vein will occur as a result of the reparative efforts of nature. A thrombus may form but will not become organized and in this case it will simply be reabsorbed and the vein will open up again for the blood stream and its reverse flow.

There are certain veins that demand repeated injections and others that will have to be treated with stronger and more destructive solutions to obtain obliteration. If the treatment is systematically carried out with the obliteration of all the collateral vessels the results will be more perfect than with any other method.

In considering the efficiency of any method of treatment and the permanency of the cure the question of recurrence must be considered. When at the end of any period after treatment the patients present themselves with scattered varicose veins over the thighs or lower legs we are faced with the question. Have these veins formed since the treatment or are they recurrences of the old veins formerly treated? This can be told in each individual case only by careful records and frequent observation. On this point we have come to the decision that if the veins are carefully and persistently treated by the more stringent method which we advocate we can be absolutely sure that they will never recur for they have become nothing but mere fibrous cords following the organization of the thrombus.

If the etiological factor is still active as might be the case when we consider the endocrine theory of Sicard the infection theory of Fischer the continued work at occupations demanding long hour standing or any of the other theories presented then we must expect to have new veins formed from the many collaterals present and these cases should not be classed as recurrences after any method. Rather they are a continuation of the pathological process and we will have to continue our injection treatment or resort to surgery at some future date. Therein lies a great advantage of the injection over the operative treatment. The first is a simple matter compared to another trip to the hospital with its attendant disability and expense.

A questionnaire was sent to 1000 prominent members of the American College of Surgeons

asking for specific data. Of the 1 000 questionnaires sent only 125 were returned. On some of these the data were so incomplete and insufficient that the reports had to be discarded. Many of the others gave only partial replies. It is from a summary of these reports that this thesis is prepared.

STATISTICAL DATA

The questionnaire as sent carried 9 questions. A summary of the replies is given in Table I. The author was surprised that admittedly poor records were kept by many men and also that as a rule but little follow up data is kept on these cases. One hundred and twenty five replies were received but because of indefinite statements on some only 119 groups of answers are included. The total number of cases reported was 6 771. The number of cases operated on by each doctor varied from 6 to 410 with an average of 54.16 per surgeon. There occurred 35 postoperative deaths from pulmonary embolus or 0.53 per cent. There was a total of 37 non fatal pulmonary emboli or 0.54 per cent. The most thoroughly reported questionnaire gave 2 fatal (0.53 per cent) and 21 non fatal (5.5 per cent) emboli in 378 cases operated upon. There were 28 postoperative deaths due to other causes than pulmonary embolus with a mortality rate of 0.41 per cent. This gives a total postoperative mortality of 0.94 per cent. In reply to question 4 (the number of days stay in the hospital following operation) there were 111 replies with an average of 15.1 days. Ninety doctors answered the question as to the intervening time from date of operation to date of resuming work. This gave an average of 34.8 days. The last group of questions as to the number of recurrences was very poorly answered. Most of the doctors said that their follow up records were very incomplete and others that no attempt had been made to keep any record at all on these cases. Only 29 doctors reported as to recurrences in 1 year and 22 as to the 5 year period. The recurrence percentage 1 year after operation was 5 per cent 5 years after it was 19.2 per cent.

Let us now consider a similar collection of statistics following the injection treatment of varicose veins. The most complete discussion in the literature on the mortality and other complications following the injection treatment is given by Dr. Carl O. Rice and myself in the *Journal of the American Medical Association*, October 13, 1928. In that article we reported a collected series of 53 000 cases treated by the injection method with only 4 fatal pulmonary emboli or a mortality rate of 0.00754 per cent.

TABLE I—SUMMARY OF INFORMATION OBTAINED FROM QUESTIONNAIRE

| | | P | g | R | Pl | s |
|---|---|------|----|----|-----|---|
| 1 | Total number of varicose vein cases operated upon | 6771 | | | 119 | |
| 2 | Number of deaths from embolus following operation | 35 | 0 | 53 | 119 | |
| 3 | Number of deaths following operation due to other causes than postoperative embolus | 28 | 0 | 41 | 119 | |
| 4 | Total number of postoperative deaths | 63 | 0 | 94 | 119 | |
| 5 | Number of cases non fatal emboli | 37 | 0 | 54 | 119 | |
| 6 | Average number of days in hospital following operation | 15 | 1 | | 111 | |
| 7 | Average number of days date of operation to date of resuming work | 34 | 8 | | 90 | |
| 8 | Percentage of recurrences 1 year | | 5 | | 29 | |
| 9 | Percentage of recurrences 5 years | | 19 | 2 | 22 | |

In the same report we found only occasional notes of non fatal pulmonary embolus and these were so indefinite that we could not use them for statistical records. In our own series we have never had a single case in which we even suspected the occurrence of an embolus other than the one fatal case reported.

No statistics could be found on the subject of fatalities after the injection treatment other than in our former report in the *Journal of the American Medical Association*. Under this heading of fatalities we must consider those deaths due to infection with general septicemia poisoning by the fluid injected, extension of the infection to produce thrombophlebitis. The latter would not occur except that it became secondarily infected and meddlesome surgery was then done. All these points are covered in our article mentioned.

The injection treatment is an office procedure and entirely avoids hospitalization. The patient's legs may become sore if the lesions are extensive and the veins are all treated at one sitting but this can be avoided or minimized if the patient is treated in stages. The patient usually continues with his daily work. Very seldom are the legs so sore and painful that he wants to go to bed and rest.

The chances for recurrences after thorough injection treatment are far less than after operative treatment since the fluid will spread through collateral superficial veins which could not be easily excised.

SUMMARY

The mortality rate from pulmonary embolus following the operative care of this condition is 0.53 per cent as compared with 0.00754 per cent following the injection treatment or approximately seventy times greater.

The number of non fatal pulmonary emboli are almost negligible after the injection treatment as compared with a frequent occurrence after the surgical treatment

Following surgery we have 0.41 per cent mortality from secondary causes such as pneumonia whereas this is rare after the injection treatment

Most of the operations are done under general anaesthesia whereas for the injection treatment nothing is required but preliminary analgesic tablets

The operative care demands an average of 15 days stay in the hospital as compared to no hospitalization for the injection method

The operative cases lose an average of 34.8 days from their work whereas cases treated by injection continue their daily routine

I believe that there will be found many more recurrences after the operative removal of a few of the varicose segments which at best can be only partial than after the injection treatment when carried out according to the technique which we advise

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EDITORIALS

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THEODOR BILLROTH

APRIL 6th of this year marked the hundredth anniversary of Billroth's birth. In the German speaking countries Billroth was the most admired and the most beloved surgeon of his time. When he died in 1894, the medical journals of Europe and America paid great tribute to his genius. Biographical sketches came forth from many renowned surgeons particularly from his former assistants who found words inadequate to describe the love and admiration they felt for their great master. Czerny, Gussenbauer, Mikulicz Salzer, Winwarther, Woelfler, Haecker, Eiselsberg, Kappeler, Gersuny, and Narath among others were formerly assistants in Billroth's clinic, and they not only admired him as their master and leader but loved and revered him unreservedly. Through them his work lives on and is handed down to coming generations.

He was born on the north coast of Germany in Bergen on the lovely island of Ruegen the oldest son of a minister. Karl Theodor Billroth and his wife Christine, nee Nagel. Of his ancestors we only know that through

the grandparents and great grandparents Swedish and French blood had come into the family. A special gift for music was recognizable here and there in his ancestry, his grandmother Frau Wilken at one time filled an engagement at the Berlin opera house as soprano. After the early death of the father the widow moved to Greifswalde where she had relatives and friends, and Theodor entered the secondary school (gymnasium). Music was his hobby and it was only due to the practical sense of his mother that he did not follow this calling. He was later however very thankful for this guidance of his mother. On the piano and the violin he made rapid strides. Even during the first semester at the university he spent most of his time studying music. It would be hard to find a more beautiful and idealistic letter in the German literature than the one he wrote as a young student to his mother on the occasion of the visit to Goettingen of Jenny Lind, the wonderful Swedish singer. The enthusiasm and ecstasy over this young and charming woman had no bounds among the students for whom she came to sing but this letter, which relates the occasion in all its beautiful details is a jewel for exquisitely rendered vivid description as well as for the ability of this crystal clear soul to feel and express the highest degree of happiness. The harmony between the sharply observing mind and the great loving heart combined with his outstanding artistic talent reveals itself as a glorious symphony which all through life won the heart of all associated with him and exercised an irresistible charm upon all who came in contact with him. After the first semester in

Greifswalde Billroth went to Goettingen where his fatherly friend Professor Baum had been called to the chair of surgery. Under his guidance he started serious studying. For the later semesters of his medical studies Billroth went to Berlin where he was particularly attracted by the professors von Langenbeck, Schoenlein, Romberg and Traube. The thesis which closed his obligatory studies was *De natura et causa pulmonum affectionis quae nervo utroque vago dissecto exoritur*. With this he was promoted Doctor Medicinae in September 185. He now had to absolve the military service and after this and some special studies in ophthalmology under his friend Albrecht von Graefe who at that time was at the beginning of his great creative work, Billroth visited the clinics of Vienna and Paris.

In the fall of 1855, he returned to Berlin to start a private practice but during the first 2 months he did not have a single patient. He then had the good luck to become assistant of Bernhard von Langenbeck, the dominant surgical authority of his day in Germany. Recognizing that years of experience were necessary for fundamental work, he at once began earnest studies in pathological histology which in those days was still little developed. Neoplasms in particular became the subject of thorough study.

In 1856 he was promoted lecturer (*privat docent*) on surgery and pathological anatomy and in the fall of that year made a trip to Holland, England and Scotland. He was now so devoted to surgery and his practical courses in operative surgery had become so well frequented that he rejected the offer of the chair of pathological anatomy at the university of Greifswalde. In 1858 he married Christel Michaelis, the daughter of the physician to the court of Berlin. The following year brought him the offer of the chair of surgery at the

university of Zuerich which he held from April 1860 till the fall of 1867. Here he entered into cordial relation with a select number of scientists and artists with many of whom he remained in friendship and correspondence till his last days. There was Griesinger, the psychiatrist, Biermer of internal medicine, Moleschott and A. Fick, the physiologists, Frey and Hermann Meyer, the anatomists, Horner, the oculist and Pindfleisch, the pathologist, all of them still young and intensely active. In the neighboring Swiss university towns likewise he found Luecke in Bern with whom he later edited *Die deutsche Chirurgie*. In Basel was Socin, the surgeon and His the embryologist. Both remained his intimate friends.

But in spite of the great demands on his time Billroth found opportunity to enjoy the arts. Luecke who came to be recognized as one of the foremost authorities in his field, lectured on the history of art. Vischer was teaching aesthetics. Semper who like Billroth later was called to Vienna, was the greatest German architect of his day. In Zuerich we find that Billroth numbered among his friends Gottfried Keller, Switzerland's foremost writer and Brahms and Hegar the composers. German surgeons like R. Volkmann and Esmarch visited him and they became fast friends. All this rich intellectual intercourse with leading personalities in all branches of science and arts was the proper soil on which to bring a personality like Billroth's to fullest development. He worked with an amazing energy and was interested in everything he found time to play the violin in a quartet which he himself arranged, he wrote keen criticisms on concerts for the daily papers, etc. but his teaching, his hospital work and his investigations in his special field always came first.



PROFESSOR THEODOR BILLROTH (1899-1894)

His book entitled *General Surgical Pathology and Therapy* rapidly became the medical bible for the German student young and old. Written in a fascinating clear and easily flowing style and presented in the form of fifty lectures it embodied a wealth of original investigation and thought. It was soon translated into nine foreign languages and Billroth's name spread over the whole civilized world as that of a scientist writer and teacher.

He devoted a great part of his time to the study of the cause of sepsis the curse of surgery. Painstaking investigations in the days before it was known how to make pure cul-

tures were described in reports on cocco bacteria of sepsis.

Another one of his publications created an innovation of immeasurable value. This was a complete report of his clinical work during the years 1860 to 1867 while in Zuerich and later in a similar manner he described his work at the Vienna clinic. Some statistics to be sure had existed before that time but they had always been on special selected subjects. This work therefore was an undertaking which required the courage of a giant to come out in the open in the days of sepsis and hospital gangrene and describe the whole sur-

ical procedure and give results thus laying the whole matter before the public for discussion and mutual enlightenment. It encouraged others to do likewise and thus stimulated open and honest debate. It also strengthened the ties between the workers by establishing the fact that they were all working together for the most noble aim of helping suffering humanity. The ennobling influence upon the interrelation between medical men is constantly felt and is surely one of the most potent factors in creating that irresistible attraction of Billroth's personality. Sir William Mac Cormac says:

Few men more than Professor Billroth could inspire one with greater sense of combined power and modesty. In manner and appearance he was most winning and sympathetic. His pupils and friends alike admired and loved him.

Twice while in Zuerich Billroth refused offers from other universities: one from Rostock and another from Heidelberg. But when Vienna called he could not resist. Here a larger field awaited him; here he had already numerous friends and soon felt at home among the amiable Viennese, though a certain degree of laxity came at times somewhat in conflict with his northern German exactitude. Innovations in the collegium of the medical teachers were hard to get through and often failed. Nevertheless Billroth rejected offers from the Charité in Berlin and from the University of Strassburg. Even in 1882 when his teacher Langenbeck in Berlin resigned and wished Billroth to be his successor the ties which had been formed in Vienna with men eminent in science and arts proved too strong for the temptation to become the leader in the country of his fathers. From all parts of Europe students and patients swarmed to him though the latter in the beginning

came more from outside than from Vienna itself.

When the Franco-German war of 1870 broke out he hurried with his friend and former assistant Czerny, then professor of surgery at Heidelberg, to the first battle field at Weissenburg where army surgeons who had to move on with the fast advancing troops were glad to leave in his charge three hundred seriously wounded who could not be transported. His experience here and later in the military hospitals of Mannheim gave origin to many valuable advances in the treatment and transport of wounded.

After his return to Vienna we find him again in the midst of an amazing amount of work. While in Zuerich he had published together with Pitha the *Handbook of General and Special Surgery*. Now a monumental undertaking and a model of lasting value came forth: *Die deutsche Chirurgie* by Billroth and Luecke. This collective work brought him into direct and close relation with all the eminent German surgeons as did the editing of the *Archiv fuer Chirurgie* which he later took upon himself. Publications in many of the leading medical journals appeared from his pen and followed each other in rapid succession. It would lead much too far to try to do more than indicate the wide range of subjects in clinical and pathological investigations in new operative undertakings even in instruction in nursing in historical studies and in critiques of important works of others. The teaching and learning of the medical science was itself the subject of several publications.

Besides all this Billroth the operating surgeon enthusiastic and yet always reliable opened new roads through which help could be brought to suffering humanity. After careful preparation and animal experimentation he successfully did the first ex-

stirpation of the larynx showed that the œsophagus could be resected and did the first successful resection of the stomach for cancer. With the last operation he blazed the trail to intestinal surgery. To quote once more Sir William Mac Cormac (1c) "As an operator his knowledge and boldness were only equalled by his brilliant execution and skill and what he did and the reasons for doing it were explained to his overflowing class with a rare talent for exposition."

His lectures were fascinating for the advanced student. The beginner however who looked for elementary textbook information was disappointed. It was not a lecture to be taken down into the notebook. The emphasis was all on medical thinking and investigating on stating what was definitely established fact and on clearly indicating where unknown territory began. Billroth relates an occurrence in his early days of teaching in Vienna. At the end of a lecture on lymphomata in which he had emphasized the lack of information as to the causes of these formations an elderly gentleman stepped forward introduced himself and said "I am happy to have heard your lecture. So truthfully have you spoken to your students as seldom happens. This man was Samuel Gross from Philadelphia. Billroth added that these words would remain cherished by him as one of the finest tributes he had ever received.

His conferees admired him, his students revered and loved him, but his assistants worshipped him. This was due to his ever kind guidance, his powerful stimulation to greater development by his own enthusiasm and perseverance when he worked from 16 to 18 hours a day, his generosity in letting them work out new thoughts and investigations after pointing them out, and finally to his fatherly deep personal interest in their welfare. His assistants filled many of the most

coveted chairs of surgery and remained ever in close friendship with their teacher.

Gersuny writes that even in his friendship with the artists and musicians one had the impression that it was Billroth who was the lavishly proffering one that he adorned his friends with all the gifts of genius and heart that he then might love them as though they came up to the pictures of his own imagination.

Honors were showered upon the master surgeon by his own and foreign governments and by medical societies. Thus to mention American societies he was a member of the Academia Chirurgica of Philadelphia, the Pathological Society of St. Louis and of the Societas Chirurgica Americana of Washington.

It was a great blessing that this sensitive though powerful personality had most happy family ties. His wife, gifted with a fine artistic sense, a keen intellect and a wonderful wit and humor, was a real partner and his letters to her reveal the rare beauty of their relation. Their home in Vienna with its princely hospitality saw frequent gatherings of select people, particularly in the world of music. Billroth himself as a critic of music was on a par with the leading authorities in this field. Johannes Brahms, the composer, and Professor Eduard Hanslick, the music critic, were on most intimate terms with him. Many of Brahms' compositions, like songs or vocal quartets, etc., were heard in Billroth's house for the first time. When the Viennese was asked in those days "Who are your greatest musicians?" he would reply "Brahms, Hanslick and Billroth." Aphorisms on music of a philosophical nature were repeatedly written by Billroth and a few days before his death on February 6, 1894, in Abbazia on the Adriatic, he sent a voluminous manuscript to Hanslick to be disposed of as he may deem fit. It was published under the title "Wer ist musikalisch?"

After a severe pneumonia in 1887 Billroth's health never fully returned and he had to reduce his social activities but the wealth of letters often written in the midnight hours show his undiminished and astounding interest in all directions his judgment and philosophy ever sure and deep At times a sad undertone is noticeable In a letter to Brahms (1890) he writes that after all those are the happiest who can draw a limit for what they want to reach and then comfortably expand within these limits Happiness in the end lies in unconscious resignation To me unfortunately this is not given The style and the

soul of Billroth's letters are of such imperishable beauty that they were gathered and published in book form after his death They are a cherished addition to the best of German literature

When Billroth's death came the whole world of culture was struck with sadness One of the noblest personalities had gone But that this master surgeon was able to clear the road to new lands which his followers could develop into rich and fruitful surgical fields this was an immeasurable blessing to humanity Such privilege is reserved for giants

ARNOLD SCHWYZER



NATHAN SMITH
1762-1829

MASTER SURGEONS OF AMERICA

NATHAN SMITH

THE spirit of the pioneer adventurous and daring challenging and confident and with that zeal resourcefulness untiring energy and more the signet of one born to lead a constant readiness for self sacrifice made Nathan Smith a chief among the frontiersmen of American medical teaching and practice In that era when the frontiers not alone of civilization but of knowledge were advanced only by the sternest efforts of men of stout hearts he contributed to the progress of his profession in this country by active participation in the establishment of four of the early medical schools those of Dartmouth Yale Bowdoin and the University of Vermont the teaching and training of thousands of young men who in their turn went forth to practice and to train others in the art of healing and the genius which made him pre eminent among the practitioners of medicine in New England The far reaching influence of his work and of his character glows in the words of praise of one of his many followers who said Dr Nathan Smith was one of the most extraordinary medical men this country has ever produced

Nathan Smith came of the adventurous and freedom loving stock of old England which emigrated to this country early in the seventeenth century to be rid of religious controversies and persecution The first of his ancestors to arrive in America was a Mr Henry Smith who brought his family and servants to Massachusetts in the summer of 1638 That this ancestor was a man of education and prominence the term Mr denoting a college graduate indicates as well as the fact that in 1662 he was a representative in the General Court

For four generations the descendants of Henry Smith lived and prospered in Rehoboth Massachusetts where on September 30 1762 Nathan Smith was born Then at some time not long after Nathan s birth ties with Rehoboth were broken and his parents removed to Chester Vermont where John his father, became a pioneer farmer On the Vermont farm Nathan s boyhood days were spent his labors the customary ones of a farmer s son and his pleasures the hunting and fishing excursions of a frontier land where dense forest and thick undergrowth concealed both wild beasts and Indians His force of character must early have shown itself for at the close of the Revolutionary War while yet a youth Nathan served with the Vermont militia to protect inhabitants against the Indians and at the age of eighteen he was promoted from the ranks to a

captaincy in his regiment At some time later he was engaged as a teacher in a district school from which we may infer that true to the traditions of his family his father had not neglected the early education of the boy

It was while engaged in this work of teaching that Nathan Smith's interest in medicine was aroused When Dr Goodhue a noted surgeon of the time came from Putney Vermont to amputate the leg of a man in Chester young Nathan was among those who gathered to watch the operation and was the volunteer who assisted by holding the leg Nathan Smith told the visiting doctor of his keen desire to enter the medical profession and following his advice studied industriously for a year with the Rev Mr Whiting of Rockingham Vermont Dr Goodhue then gave him a home and medical tuition in return for necessary work Three years were thus passed until in 1787 at 25 years of age Nathan Smith began practicing medicine at Cornish New Hampshire before he had received a degree from any of the three medical schools then existing in the United States

For two years the young physician practiced at Cornish until impressed by the need and importance of further study he gave up his work there to attend the medical lectures at Harvard where he took the degree of M B in 1790 He then returned to his friends and his practice in Cornish and in 1791 was married to Elizabeth Chase of that town Her death occurred about two years later and in 1794 he married her half sister Sarah Chase

Throughout the span of his years Dr Nathan Smith might have continued to reside comfortably and with honor and profit among his Cornish friends His marriage had allied him to a family of more than ordinary means and position as the only physician in the neighborhood he soon acquired a large practice and his knowledge and skill began to win for him repute in distant places But a life of complacent ease was entirely foreign to his nature Instead his life was one of hardship and self denial his independent spirit forcing him to live within the bounds determined by his own small income his practice requiring long and arduous days and nights on horseback and in stage coaches And there was in him ardor and energetic restlessness ambition and a desire to promote the welfare of his profession which urged him constantly to new endeavors He was not only a practitioner but a diligent and questing student and he desired to be a teacher

In 1796 therefore he submitted to the Trustees of Dartmouth College at Hanover New Hampshire a plan for establishing a professorship of the theory and practice of medicine in connection with the college This novel plan while approved by those to whom he presented it was not acted upon finally before another year During that year by means of great self sacrifice and in spite of almost insurmountable difficulties chief of which was his limited resources he journeyed to the University of Edinburgh for further study From Edinburgh he went to London where he engaged in hospital work before returning to America

Later in the fall of 1797, he gave the first full course of medical lectures at Dartmouth and in 1798 the plan he had originally proposed was adopted. He was then appointed a professor 'whose duty it shall be to deliver public lectures upon anatomy surgery chemistry and the theory and practice of medicine'

The medical school thus established at Dartmouth was the fourth to be founded in the United States and owed not only its birth but its upspring to the one man whose trials and discouragements met and conquered in its behalf were such that few other men would have persisted. Its first accommodation was a small two story frame structure of four rooms which was used until 1799 when a room in Dartmouth Hall was fitted up and given over to Dr. Smith for his use. Yet the school flourished and in 1801 forty five men were attending the medical lectures although Dr. Smith's only assistant was a pupil whom he employed at his own expense to give three courses of lectures in chemistry and to help him with his practice. In 1803 by personal application to the Legislature of the State of New Hampshire Dr. Smith acquired an appropriation of six hundred dollars for medical apparatus for the school and in the same year the college provided for him another room in Dartmouth Hall adjacent to that already in use the two rooms serving for lecture hall dissecting room chemical laboratory and library.

Excepting for the aid of these gestures in his behalf Dr. Smith carried on the work of the medical school through its early years at Dartmouth quite at his own expense and by his own efforts. In addition to this burden he maintained his home in Cornish and received during the summer months, a number of students at Windsor Vermont adjoining Cornish and gave them private instruction. For the expenses of the school and the support of his family he was dependent upon the small pay then extracted from medical students and the meagre returns from a practice which though extensive was far from lucrative and attended only under the greatest difficulties. In one of his letters he speaks of attending a patient eighty miles above Hanover in another he refers to an amputation in Montpelier Vermont and again he writes of a successful cataract operation performed in Worcester Massachusetts.

It was not until 1804 that Dartmouth College saw fit to grant him a salary and to enable him to concentrate his efforts in teaching to one locality. In that year the trustees of the college voted him a salary of two hundred dollars a year upon the condition that he remove his family from Cornish to Hanover. Early in 1805, therefore Hanover became his settled home and there was removed the necessity of his journeying to and from Cornish.

The medical school continued to prosper and in 1810 Dr. Smith was granted by the state legislature the sum of three thousand four hundred fifty dollars with which to erect a building for the establishment on the condition that he should give a site for it and assign to the state his anatomical museum and chemical apparatus. The state had driven a hard bargain but not one which Dr. Smith

was unwilling to accept or even to amplify. In addition to the appropriation it was necessary for him to expend from his own resources one thousand two hundred seventeen dollars to complete the work a building of brick seventy five by thirty two feet having two commodious lecture rooms in the two story center and two three story wings for library and chemical museums. In that year too the College first employed at his request one of his pupils to occupy the chairs of anatomy and surgery and thus somewhat lightened the burden of the man who had for so long carried on the work of the school single handed. Nevertheless owing to state politics and the poverty of the college Dr. Smith found clouds of difficulty closing in around his work in Hanover and though he had felt willing to go to all lengths in sacrificing on the Esculapian altar he wrote at last to a friend that he had determined to sell his talents in physic and surgery to the highest bidder. At this time he was no doubt influenced by the prevalent pessimism surrounding the Dartmouth College case which was about to be launched into its now famous litigation. The tremendous start given by Dr. Smith to the medical school at Dartmouth and his skill and energy in carrying on the work had spread his reputation far and wide. From the years 1798 to 1818 for example the school at Dartmouth graduated 340 students.

Dr. Smith left Hanover in 1813 his known ability as an organizer and teacher and as a skilled practitioner of medicine and surgery having resulted in a call to the new medical school established in the previous year at Yale. He did not immediately sever all connections with Dartmouth however for he returned to Hanover in 1816 to deliver a course of lectures and his family remained at the New Hampshire home until 1817 following the graduation from the college of the second son. In addition to his work as Professor of the Theory and Practice of Physic Surgery and Obstetrics at Yale Dr. Smith rapidly acquired a large practice which carried him into every county in the state of Connecticut.

The impulse given by Dr. Smith toward advancement in the knowledge of medicine and surgery extended throughout the country and the necessity for good medical schools began to be felt in many states. The University of Maryland was first to follow Dartmouth and established its school in 1807. Then in rapid succession during the next ten years five other medical schools sprang into existence headed by that at New Haven. In 1810 according to President Allen of Bowdoin College the first legislature of the new state of Maine passed an act establishing and endowing the Medical School of Maine and he asserts that the creation of this school may be in no small degree ascribed to the fact that Dr. Smith had been consulted on the subject of being placed at the head of it. When this new school was opened in 1821 Dr. Smith went to it from New Haven for ten weeks and delivered the various lectures with the exception of those in chemistry. There were twenty one young men in attendance at the first course of lectures. The next year the number increased to forty nine. In the year

1829 there were nearly a hundred and Dr Allen ascribed much of the success of the school to the reputation, experience and skill of Dr Smith

A few months after the establishment of the new medical school at Bowdoin, the University of Vermont began its medical department at Burlington and called to the professorship of surgery and anatomy, Dr Smith's son Dr Nathan Ryno Smith, through whose exertions aided by those of his father, the school was organized. While still faithfully discharging his duties at Yale and at Bowdoin Dr Nathan Smith visited the Burlington School and not only delivered courses of lectures there but by constant correspondence with his son, gave it the benefit of his wisdom and experience thus as the colleague of his son aiding the establishment of a fourth medical school in New England. His son later aided also in the establishment of the Jefferson Medical School of Philadelphia where again Dr Nathan Smith's services were enlisted and his influence and judgment felt.

Early in January of 1829 Dr Nathan Smith was stricken with an illness which, though of short duration left him weak and debilitated. From this state he did not entirely recover and on January 26 died at the age of sixty seven. Many and eloquent were the eulogies pronounced upon him by ardent and appreciative admirers of his character and work. His ripe knowledge and keen observation, after a life of study and vast experience had fitted him not only to become the leading physician and surgeon of his day but his rare talent for communicating his learning enabled him to instruct thousands of students in the medical schools to whose establishment he contributed so much.

Although it is perhaps as a teacher and organizer of medical schools that he is best known today, it is impossible even in a brief sketch of his life and work to overlook Dr Smith's talent as a practitioner. His success in treating patients in the epidemic of typhoid then called typhus fever, which occurred in Hanover and the surrounding country in 1812 was remarkable. As early as August of 1800 he had been practicing vaccination. In 1821 he performed the operation of ovariectomy the second one of its kind the first having been done nine years earlier by Dr McDowell of Kentucky. Dr Smith however had no knowledge of this previous operation. He was also the first surgeon in America to perform staphylorrhaphy. In fact, he was the first to perform a number of important surgical operations and in this branch of his profession not less than in medicine he was an innovator and reformer.

Dr Smith's descendants took up and continued his work and it is probable that there is hardly a family in the country in which so many of its members have adopted the profession of their progenitor. Since his death four sons nine grandsons six great grandsons and one great great grandson have practiced the art of healing. Thus the influence of his life's work has been perpetuated and his memory preserved within the hearts of men as well as in the schools he founded.

JOHN POLLARD BOWLER

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN M D F A C S OMAHA NEBRASKA

THE UNIVERSAL CANONS OF MESUE

WHEN the title of one of the old books on medicine and surgery is read including as it does the names of several men of different generations the question at once springs up in the mind whether the book should be considered as the work of the individual whose name it bears most prominently or whether it should be taken rather as a collection of the data of the time possibly by several authors and thus represent a period rather than an individual.

The work of Mesue the younger affords a good example of the question mentioned. Its title reads

Mesue with the exposition of Mundinus concerning the universal canons and also with the exposition of Christophorus de Honestis concerning its antidotary. The additions of Peter of Apennin (Abano). The additions of Franciscus of Piedmont. If we consider the Mesue of the title to be Jahja Ben Maseweh Ben Ahmed of Maradin on the Euphrates who was the physician of Alhakem II at Cairo and who died in 1015 the period covered by the book stretches over more than three centuries for Mundinus de Luza lived from 1275 to 1326. Peter of Abano lived from 1250 to 1320. Franciscus of Piedmont flourished about 1330 and Christophorus de Honestis the professor of medicine at Bologna and Padua died in 1397. Here then is a book the product of over three centuries written before the invention of printing and handed down in manuscript form. How can it be considered the work of one man except in the broad interpretation of his ideas? The writer cannot be Mesue the elder.

Abu Zachariya Ben Maseweh who was a product of Jondisabur physician to the Caliph Harun and director of the great hospital and school at Bagdad during the ninth century for his work is known and his history likewise fairly authenticated. In the book this Mesue is referred to under several names. In the beginning of the *Universal Canons* edited by Mundinus he is referred to as Joannus son of Mesue son of Hamech son of Heli son of Ahdelah king of Damascus. In the medicine proper he is called Joannus the Nazarene son of Mesue—consequently he was probably a Christian and one of the Arabian school serving under Mohammedan rule though retaining his faith and if the genealogy of the book is to be believed a descendant of the original Mesue who was known also as Janus Damascus. The book was printed at Venice by Bonetus Locatellus

for Octavius Scotus in 1495 and bears the printer's mark of Scotus. According to the colophon it includes all the works of Mesue here described as Divine Joannus Mesue. The work shows evidence of being written after considerable study and compilation. The ancient authors are constantly referred to even those of the time of writing or shortly before such as the son of Serapion and Rhazes who is referred to as the son of Zachary. A list of authors to whom reference is made would give a list of almost all the men who had written up to the time.

The *Universal Canons* first takes up diseases of the head and continues through the body to diseases of the joints and ends with chapters on fevers and apostumations. The surgical portion is scattered here and there. Ligature of arteries is described clearly. For vesical stone extraction through the perineum is advised and technique given. As a nose and throat surgeon Mesue is most interesting and his description of removal of polypus seems worthy of quotation. 'The polypus which is in the nose hard black is not easily managed and the soft putrid fetid (one) is perhaps not curable. And the one which is elongated and hangs sometimes outside having a thin slender pedicle not too deeply situated is cured by cutting next to its pedicle with scissors after which it is grasped and drawn out with a tenaculum and then the incision over the part of the pedicle that remains is cauterized either with a hot iron or caustic medicaments. This is repeated many times as is done for mundification of the body after phlebotomy. And when haste is requisite cauterize until there is a flow of fluid from the nose as is stated in the part which treats of the cure of catarrh and coryza. If however the polypus descends through the foramen of the palate to the palate and throat draw it similarly with a tenaculum cut its root with a hot scissors when it is cured with caustic medicines as I have said before. If however its incision can not be done easily in the manner I have described then take two or three hairs of a horse's tail and twist each of them by itself then retwisting make as if one hair and make in it three or four knots. It is placed in the nose with a lead needle and passed with it to the foramen of the palate and is drawn through the palatal opening easily until the hair comes out through the foramen of the palate. Then grasp each end of the hair and draw it to and fro after the manner of a saw until all the flesh is cut through and if any remains do as is stated above.

REVIEWS OF NEW BOOKS

TORSDIKE'S little book on *Sterility in Women: Diagnosis and Treatment*¹ is distinctly a reflection of painstaking practice of a practical physician. In it the author wastes no space with lengthy quotations from the literature but includes brief discussions of those procedures which he has found usable. His plan of investigation of the childless woman and her husband as described is orderly, adequate and thorough. None of his methods is open to criticism, an exception being his criterion of safety in the performance of the Rubin patency test. In reference to the latter he says that he does not hesitate to employ a pressure of 300 millimeters of mercury provided the patient is conscious and tolerates it. He further states that if a pressure of 300 millimeters is reached that he believes the tubes are definitely closed unless the uterus lies in complete retroversion. The reviewer agrees with Rubin and other authorities who maintain that the maximum pressure should not exceed 300 millimeters of mercury. Perfectly normal tubes are usually patent at low pressures (40 to 100 millimeters) although repeated tests, antispasmodics or change in posture may be needed to determine the fact. Greatly increasing the pressure often tends to call forth greater muscle spasm.

The book contains a number of illustrations among them many prints of X-ray films taken in cases in which lipiodol was injected. The author wisely warns that unless great care is taken in the interpretation of the X-ray negatives conclusions may be erroneous. Considerable experience is needed and often repeated examinations are required before the results can be evaluated. His results with gas inflation of the tubes and those after lipiodol are summarized and compared. Fifteen women became pregnant out of 100 in whom he made the Rubin test. Forty seven of the 100 were patent. On the other hand 14 women became pregnant of 67 in whom lipiodol was used. Forty one of this group were patent to lipiodol. The author concludes that when all fallacies and objections have been taken into account there can be little doubt that these two methods have earned an important place in both the diagnosis and the treatment of sterility. Torsdike's investigations and his conclusions are in accord with those of most investigators on the subject and his book will be found to be of interest and value.

I F S

THIS *Textbook of Urology*² is intended primarily for the use of students and practitioners and attempts to present the subject in the simplest

possible manner. The book serves these purposes well and will undoubtedly make an excellent text for medical students to follow. The subject matter is logically arranged and treated with clarity of expression. Throughout the text the more important items of each paragraph are printed in bold faced type.

The book is nicely and profusely illustrated. In many instances the gist of the subject matter is clearly depicted by diagrams which should prove to be especially helpful in teaching.

The first eleven chapters deal with the urologic subjects of more or less general interest such as anatomy and physiology, terminology, instruments, minor technique, cystoscopy, radiography, laboratory methods, anesthesia and the methods of urologic study. These chapters are well done. The chapters devoted to terminology and urologic study will probably be of definite aid to students.

The next ten chapters quite thoroughly cover the subjects of gonorrhoea and venereal ulcers.

Following this the various urologic diseases are anatomically arranged. The discussion of each disease is sufficiently complete without being lengthy and the arrangement is good. The debatable subjects especially those related to treatment are usually presented in an unbiased manner although the authors seem somewhat too enthusiastic to the reviewer concerning the value of vasotomy in the treatment of chronic prostatovesiculitis. The bibliography is not intended to be complete but the more important references are given.

The last part of the book is devoted mainly to operative technique but also includes chapters on postoperative complications, anuria and the interpretation of hæmaturia and pyuria. The various operative procedures are well illustrated and described in sufficient detail.

Unfortunately a few minor typographical errors have been allowed to appear in the text but the book can well be recommended as an excellent text book of urology.

J J J

THE monograph of Marriott's³ which consists of a series of six lectures given before the San Diego Academy of Medicine is a valuable and practical summary of recent advances in chemistry with their practical application to their everyday use in medicine. It is deserving of a large and wide distribution. Recent graduates of medicine probably will find it less instructive than those of a few years back because of their more thorough training in physiological chemistry and by reason of the very recentness of so much of the knowledge touched upon in these lectures. It could however be used as an adjunct text in many medical schools as a review and

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ph. u. a. d. Lond. n. J. B. L. pp. n. o. t. t. Company 1918

will be continued on Tuesday and Wednesday. This conference is planned to interest surgeons, hospital trustees, executives and personnel generally, and an invitation to attend is extended to all persons interested in the hospital field.

General headquarters for the Congress will be established at the Stevens Hotel, located on Michigan Avenue between Seventh and Eighth Streets, where the grand ballroom and many other large rooms have been reserved for the exclusive use of the Congress for scientific meetings, conferences, registration and ticket bureaus, bulletin boards, exhibits, executive offices, etc. The grand ballroom will be utilized for the evening meetings, hospital conferences, and other large gatherings.

An application for reduced railway fares on account of the Chicago meeting is pending, and at this time it seems assured that a rate of one and one-half the regular first class one-way fare will be in effect from all points in the United States and Canada.

In recent years a number of fine large hotels have been built in Chicago, among which is the

Stevens, with its more than 3000 guest rooms. Ample first class hotel facilities are available, many of the hotels being located within short walking distance of the headquarters hotel.

LIMITED ATTENDANCE

Attendance at the Chicago session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics, and insures against over-crowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

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